

GARDEN BEANS

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Garden beans, along with corn, the white or Irish potato, sweet potato, and tomato, are valuable food plants which were first found in the New World. Cultivation of the garden bean is now extensively practiced over the world. For the home garden, no matter how small, at least one planting of snap beans is considered essential. Such consideration is merited and is due to the fact that all are acquainted with the excellent table qualities of garden beans. Beans, as well grown products, please the palate and thus aid all digestive processes. In the fresh or green condition they contain appreciable amounts of the vitamins or substances essential for growth and general well-being. Shelled and dried beans contain great amounts of energy-producing substances as shown in the following table.

TABLE 1.—ENERGY-PRODUCING SUBSTANCES IN VARIOUS FOODS*

	Per Cent Water	Per Cent Protein	Per Cent Fat	Per Cent Carbohy- drates	Per Cent Ash
Fresh Beans					
Snap beans	89.2	2.3	.3	7.4	.8
Shelled kidney beans	58.9	9.4	.6	29.1	2.0
Shelled lima beans	58.5	7.1	.7	22.0	1.7
Dried Beans					
Lima beans	10.4	18.1	1.5	65.9	4.1
Navy beans	12.6	22.5	1.8	59.6	3.5
White or Irish potatoes.....	78.3	2.2	.1	18.4	1.0
Cabbage	91.5	1.6	.3	5.6	1.0
Rolled Oats	7.7	16.7	7.3	66.2	2.1
Wheat breakfast foods	9.6	12.1	1.8	75.2	1.3
Lean beef	70.0	21.0	7.9		1.1
Eggs	73.7	14.8	10.5		1.0
Cheese	34.2	25.9	33.7	2.4	3.8
Tomatoes	94.3	.9	.4	3.9	.5

*Data from Farmers' Bulletin 121, Page 17.

The amounts of carbohydrates in shelled and dried beans are surprisingly high, being higher than that in potatoes and about as high as the amounts in bread. The protein content of dried beans is higher than that of eggs and about as high as that of lean meat. With such pleasing flavor, when properly prepared, it is little wonder that beans have and deserve a place in every garden.

Beans rank second only to potatoes in value among the vegetable crops, commercially. The average yearly value of fresh beans (snap beans and lima beans) from 1928-1932 in the United States was about \$19,000,000. The average yearly value of dry edible beans from 1928-1932 was about \$50,000,000.

In the home garden beans rank ahead of potatoes in importance. This is true since beans are harvested in the fresh condition over the greater part of the growing season, and are produced in the dry shelled condition for use throughout the year. In the smaller home gardens potatoes are not grown, and this more seldom holds true in the case of beans.

VARIETIES

Snap Beans.—There are a great number of varieties of beans, especially of the kidney type. Within each group of kidney beans (green, wax, dwarf, pole), many varieties are listed in the various seed catalogs. Green podded dwarf or bush snap beans are the most popular; although some prefer the wax varieties. There are also wax varieties as well as varieties with green pods in the pole or climbing sorts of snap beans. Garden beans of the kidney type have

often been referred to as string beans. With the newer and superior varieties, it would seem that "snap beans" would be more applicable, since the "strings" are practically absent when good strains of the better varieties are well grown.

For several years Burpee's Stringless Greenpod has been the standard by which dwarf or bush green podded snap beans were judged. The plant is sturdy and vigorous, being as resistant to injury by the high temperatures and bright sunshine of the drought years in Missouri as any variety. When the pods are removed in the early edible stage and not allowed to develop too far, the plants may continue to bear more or less throughout the growing season when free from disease and when weather conditions are favorable. Burpee's Stringless Greenpod is at its best when the pods first reach edible size; although it is very good as a green shell bean. The mature dry beans also rank high in quality. The plant is productive, but good seeds free from anthracnose are quite essential since the plant seems susceptible to anthracnose and the disease may spread rapidly when once established in a planting. The same holds true in regard to mosaic which disease may be carried in the seed. From a few early diseased plants, mosaic may spread pretty well throughout a planting before the harvesting period is over.

Tendergreen is a newer variety of snap bean of great merit. As indicated by the name it is a green-podded sort. The quality of Tendergreen as a snap bean is scarcely as high as that of Burpee's Stringless Greenpod and it may not be quite so resistant to sunburn. It is a vigorous and productive plant, however, producing an abundance of pods of rare smoothness and uniformity. On the market this snap bean will undoubtedly take precedence over any other green-podded snap bean since the smooth, uniform pods are so much more attractive than those of most any other variety. The pods of Burpee's Stringless Greenpod are often rough and lacking in uniformity. In the earliest edible stages the pods of Tendergreen are exceedingly tender and delicious when properly prepared. Tendergreen is so new on the market that little is yet known in regard to its quality as a green shell bean or in the dry shelled condition.

For green shelled beans, Dwarf Horticultural ranks about the highest. This is quite an old variety and is also known as Wren's Egg and Speckled Cranberry. The dried shelled beans of this variety are also excellent. As a green snap bean it is good but is more likely to be "stringy". Dwarf Horticultural is fairly productive, but is not so resistant to the high temperatures and bright sunshine of the Middle West. The leaves are much more likely to suffer from sunburn and drop early than are those of Burpee's Stringless Green-

pod and Tendergreen. Dwarf Horticultural is also less likely, in Missouri, to continue productive even though the pods are removed at an early stage.

Pencil Pod Black Wax is one of the best wax bush or dwarf beans with black seed. Brittle wax and Golden Wax are also excellent varieties.

Kentucky Wonder is still the most important pole snap bean. It is vigorous, the leaves are quite resistant to sunburn and it is exceedingly productive. The quality, however, is decidedly lower than that of Burpee's Stringless Greenpod or Tendergreen. It is used to some extent as a dry shell bean.

Horticultural is the pole variety similar in fruiting to the dwarf derivative. Like the Dwarf Horticultural, this variety is excellent for fresh shelled beans. The quality is much higher than that of Kentucky Wonder, but it is not so vigorous and resistant to sunburn and usually not nearly so productive.

Lima Beans.—Bush or dwarf lima beans are more important for the home garden than the pole or climbing types. This is true largely because the dwarf limas come into bearing earlier and thus furnish fully as high quality product as the pole limas over a longer period. Bush limas are more dependable bearers, especially certain varieties, than pole limas.

Henderson's Bush lima bean is the most satisfactory of the limas for Missouri. This variety comes into bearing earlier and is a more certain bearer than any of the other varieties. The quality of the product fresh from the garden is certainly high. Some contend that the more fleshy varieties are higher in quality. The Henderson's Bush lima is not large and may not be as palatable as some of the large varieties, but, so far as texture and flavor are concerned, the Henderson's Bush lima ranks high. The plant will withstand drought and intense sunshine better than the plants of other common varieties. Once in bearing, it will continue to bear until frost, provided there is ample moisture. In very dry weather the flowers may abort, but with late summer rains the plants revive, blossom, and bear.

Burpee's Improved Bush lima gives promise of producing good yields of large high quality fresh limas. The "Improved" variety is really quite an improvement over the Burpee's Bush lima which is not a good bearer in Missouri. Henderson's Bush lima is an earlier variety than Burpee's Improved Bush lima, but the product of the latter is much larger and of very high quality.

The so-called potato limas or large limas represented by Fordhook Bush lima and Dreer's Bush lima are not so satisfactory in Missouri. These varieties come into bearing late and are not good bearers.

Pole Lima Beans.—King of the Garden is perhaps the most widely planted pole lima. This is usually a productive variety, but comes into bearing much later than some of the bush varieties. Early Leviathan is earlier than King of the Garden and about as productive. As a rule pole lima beans will not give the satisfaction in Missouri as bush varieties, such as Henderson's Bush lima and Burpee's Improved Bush lima. This is due primarily to the fact that the pole limas come into production so much later than the bush varieties, thus making the period over which the product is available very much shorter.

PLANTING

Beans are very tender plants, especially the limas. The seed should therefore not be planted until danger of frost after the seedlings are likely to be above ground, is definitely past. In order to obtain snap beans as early as possible, a chance may be taken with them by planting a limited amount of seed as soon as the ground has warmed sufficiently for germination to take place fairly quickly. In case light to medium frosts come after such a planting is up, the plants must be protected by some type of cover. Mounding soil over small plants may be a means of protecting them against, not only a frost, but even a freeze. A covering of newspaper with the edges held down by soil will give excellent protection *provided the cover is not less than three sheets in thickness*. Burlap or cardboard may also be used as a cover.

Lima beans must not be planted before the ground has warmed up sufficiently for germination to take place promptly. Beans ferment and decompose before germination can take place when the temperature of the soil in which they are planted remains low for too long a period. This is especially true in regard to lima beans. In the latitude of Columbia, lima beans are normally not planted before May 10, but snap beans are often planted in April. For the northern part of the state, the planting date is a week to 10 days later than that mentioned above, and for the southern part, about a week to 10 days earlier.

Since bean seedlings come through the ground with more difficulty than those of most other plants, it follows that the soil, to receive the seed, must be in the best of condition—well and deeply pulverized and loose. Soil for beans, as for all vegetables, should be well supplied with organic matter which makes for ease in pulverizing the soil and

tends to keep it in a loose condition. Organic matter also tends to prevent the formation of a crust. At any rate the texture of the soil should be of such character as to make packing and formation of a crust less likely. Beans may be grown on a great variety of soils provided sufficient moisture and other plant nutrients are available. Well drained soil is always essential. A loam or sandy loam soil is preferable.

Beans are usually drilled in the row in preference to planting in hills. When drilled in the row the plants are more evenly distributed and thus make better use of the space available. With the same amount of seed, drilling the seed not closer than 4 inches and not farther than 6 inches apart will give more economical returns than planting in hills. Hill planting, however, when properly checked, will permit cross-cultivation and thus reduce the amount of hand labor required to keep the planting free of weeds. The rows should be about 20 inches apart where hand cultivation is practiced and 30 to 36 inches apart where cultivation by horse-drawn equipment is intended.

A hand seed drill is very convenient for making small plantings of beans. Where several acres are to be planted, a two-row corn planter with special bean plates may be used.

The following table gives the approximate amount of seed of some varieties required to plant 100 feet of row and one acre with the seeds placed 4 inches apart in rows 30 and 36 inches apart.

TABLE 2.—AMOUNT OF SEED REQUIRED IN PLANTING BEANS.

Variety	Ounces of seed per 100 ft. 4" apart in the row	Pounds of seed per acre	
		4" x 30"	4" x 36"
Burpee's Stringless Greenpod	5	48	40
Giant Stringless Greenpod	4	44	37
Dwarf Horticultural	5	53	44
Tendergreen	4	41	35
Bountiful	5	46	38
Black Wax (Pencil Pod)	4	39	33
Brittle Wax	5	50	42
Golden Wax	4	44	37
Kentucky Wonder	4	44	37
Navy	3	28	23

Pole beans are most often grown in hills, especially where the plants are to be staked. Woven wire fencing four to five feet high makes an excellent support for pole kidney or pole lima beans. For lima beans the five foot height is most desirable. After the plants have attained the height of the fencing, they may be trained along the top. The wire may be stretched across the garden plot and the seeds planted at 4 to 6 inch intervals on each side of the fencing.

It is quite necessary to have such a support for beans well anchored in place by strong stakes at frequent intervals to prevent the wind from blowing it over.

Beans should be well covered with soil on being planted. The depth of planting should be not less than three to four times the shortest diameter of the seed. Where the planting is small and time is available, much better results will be obtained with the larger seeded limas such as King of the Garden, Fordhook and Dreer's Bush lima by placing each individual seed in the ground with the hilum or "eye" down. This will better enable the seedling to come through the soil. Should a crust form on the surface of the ground after planting, this should be broken by the careful use of a garden rake.

Plantings of bush snap beans should be made about every three weeks in Missouri, throughout the growing season, in order to assure a constant supply of young tender pods from the home garden. It is true that where this is practiced, due to various factors, some of the plantings may be ready for harvest at the same time. A temporary oversupply of pods may thus be produced. It is in this way, however, that the supply of canned beans may best be assured without too much drudgery attached to the task. Putting up a few cans from time to time would seem to be less irksome than canning the entire supply at one time. A better canned product is assured where only small amounts are canned at any one time. This is true since the pods are in a more fresh and turgid condition.

Repeated plantings of lima beans are not necessary since the lima bean plant continues, under favorable conditions, to produce throughout the remainder of the season once it begins to fruit. This is true especially where the pods are removed as soon as the seeds have attained sufficient size for table use.

Inoculation of seed with nodule-producing organisms before planting is advisable where the seeds are to be planted on soil which has not produced a crop of beans recently. Inoculation may be accomplished by using a culture or simply by mixing with the seed soil from a bean plot where nodules were present on the roots of the plants. Beans will thrive where there is sufficient available nitrogen without the presence of nodules. The presence of nodules is always desirable, however, and in a garden plot where beans have been grown a number of years in succession, nodule organisms are most sure to be present. Lima beans require a different organism for the formation of root nodules from that which is required by kidney beans.

For a very early crop bean seedlings may be started indoors and these transplanted to the outside as soon as weather conditions will permit. Transplanting bean seedlings, however, is rarely practiced. They transplant with difficulty and there is little gain.

CULTURAL REQUIREMENTS

Plantings of beans must be kept free of weeds. The best and easiest means of keeping down weed growth is to kill the weed seedlings just before or immediately after they have come through the ground. One can easily accomplish this by cultivating the ground at sufficiently frequent intervals. Weeds must not be allowed to become established in the garden. They do injury by robbing the vegetable plants of moisture and other essentials for growth; consequently the earlier in their growth stage weeds are removed, the more benefit will such removal be to the vegetable plants.

To prevent weeds from getting a start, shallow or surface cultivation should be frequent. In preparing the soil for planting, cultivation should be deep and thorough to pulverize it completely to as great a depth as possible. After the plants are established, however, only shallow or surface cultivation should be given. This surface cultivation should preferably result in removing the weeds and stirring the soil to a depth not greater than one inch. Certainly this holds true for cultivation near the plants, but since the feeding roots of well established plants may soon, if given opportunity, occupy all the space between the rows, shallow cultivation over all the surface will give best results.

When the ordinary type of garden hoe is used in the garden, it should not be used to dig or chop deeply or to hill or mound up the plants. Level cultivation is considered generally most desirable since hilling or mounding increases the surface from which moisture may be evaporated and hence is likely to increase the rapidity of drying out of the soil. Hilling or mounding may only be justified in wet locations or during wet seasons in order to facilitate drainage of excess moisture away from the soil about the plant.

Where some type of plow is used, this should be set so that the stirring of the soil will be shallow, especially near the plants. Disk or shovel cultivators when set to throw the soil away from the plants are undoubtedly very objectionable in a dry season, since the plants are left on a narrow ridge. A great part of the root systems of the plants is severed from the plants by such practice. This may cause the plants to suffer from lack of moisture and is certain to retard their growth.

In cultivating it is best to operate the tools, where possible, so that one does not walk upon the cultivated soil. This is quite important to avoid again packing and firming the soil immediately after it has been cultivated. Beans should not be cultivated soon after a rainfall of one-half inch or less. Light rains do not wet the soil deeply and stirring the soil soon after such a rain may only serve

to expose more of it to be dried, and hence hasten the loss of the small amount of water which the soil has received. Such diseases as anthracnose and mosaic are quite readily transmitted from diseased to healthy plants, especially when the plants are wet. Beans, therefore, should not be cultivated when the plants are wet, whether they are wet by dew or rainfall.

Mulching

Mulch paper, especially black paper mulch has been used in the springtime to keep down weeds and also to secure an earlier crop, since the soil warms up readily under such a mulch during sunny days. In midsummer during periods of high temperature and bright sunshine, in the Middle West, the tendency to warm up under such a paper mulch may be so great as to be detrimental instead of helpful. The value of mulch paper therefore is questionable.

Beans do respond very favorably to a heavy mulch of plant debris, such as leaves, dead weeds, or dead grass. Remains of bean plants should not be used as mulch material, however, for fear of introducing diseases. Such a heavy mulch conserves moisture, keeps down weeds, enables one to walk about the plants without packing the soil, and leaves the soil in an especially good condition for the next year.

Watering Plants

In any growing season, especially in Missouri, there are likely to be dry periods during which beans should be watered, providing a good supply of water is available. During such dry periods, if water is supplied in time the plants may continue growth and setting of pods unchecked until the next rainfall. In this way the yield may be increased and the quality of the product improved over that which has been checked in growth. To obtain the best results with beans, the plants should grow rapidly and continuously to maturity.

Where a planting is located on nearly level land, with the elevation at one end of the rows slightly greater than that at the other, water may be run through small, shallow furrows on either side and near the rows of plants. If the furrows are made winding, the flow of water will be checked and the rate of absorption by the soil will be increased. This system is superior to flooding the entire surface of the soil. Surface irrigation by means of trenches is an excellent method of carrying a planting of beans through a drought period. The water should always be applied in the evening as this gives the water time to penetrate the soil and revive the plants before the heat and wind of the next day cause evaporation of an appreciable part of the water applied.

Fertilizers

Even though beans, under certain conditions, are able to utilize nitrogen from the atmosphere, due to organisms in the root nodules, on most soils the plants will respond to moderate applications of nitrogenous fertilizers. Fertilizers containing nitrogen only, however, should not be applied alone but in combination with phosphate and potash bearing constituents to make what is known as a complete fertilizer. The best method of application is to apply 200 to 300 pounds of a 4-12-4 fertilizer per acre at planting time in a band on both sides of the row, 3 to 4 inches from the seed, and at the same depth. For the home garden a handful of a 4-12-4 fertilizer for each side of every 20 feet of row should be ample.

DISEASES OF GARDEN BEANS

Anthracnose and bean mosaic are the two most common and important diseases of beans in Missouri. Both diseases are carried over from one year to another by the seed. It is, therefore, very important to obtain disease-free seed. Anthracnose is also carried over by the old bean plants. Burning the old plant remains at the end of the season will aid in controlling the disease.

Removing the individual mosaic diseased plants as soon as the disease is evident will greatly assist in controlling mosaic. One should therefore be able to recognize mosaic diseased plants. It is almost impossible to write an adequate description which will enable a grower to recognize the disease. A picture, other than one in colors, is also inadequate. The best way to learn the characteristics of the mosaic diseased plant and thus be able to recognize it is to have your county agent or extension horticulturist point out diseased specimens in the field.

INSECT PESTS OF GARDEN BEANS

Foliage-destroying beetles of the ladybird beetle type are often serious pests in Missouri. The bean leaf beetle, dull red in color, about $\frac{1}{4}$ inch long and with several black spots on its back is coming to be especially objectionable. The mature beetles feed upon the leaves, and often upon the tender pods. Cleaning up the garden area in the fall, giving the beetles no good place to hibernate, will assist in control. In small gardens the beetles may be killed by hand. In large plantings where this pest becomes serious, dusting with equal parts of hydrated lime and lead arsenate is recommended. Dusting the plants with lead arsenate should not be practiced after the pods

have formed. For detailed information on control of garden insect pests, see Missouri Agricultural Extension Service Circular 304. Control of the bean weevil is discussed below.

HARVESTING

Green beans, when used as snap beans, are best when the pods are harvested before the seeds have developed to any appreciable size. When this is practiced and all pods are removed considerably before the seeds have reached the shell bean stage, it is possible to maintain plants in a continuous state of productivity throughout the growing season, providing ample moisture is present and the temperature does not go too high.

For shell beans, the pods are allowed to remain on the plant until about one-third or one-half of the pods are ready to be shelled when picked.

STORING SEED

A cool dry place is preferred for storing dried beans. Where the quantity to be carried over is not large, tight containers such as tin cans with perforated lids may be used. This protects the product from dirt, rats, mice and insect pests. Storing in a dry place in an unheated building where the seed will be exposed to the temperature of the outside atmosphere gives good protection against insect pests, since insects are not so active at low temperatures. Low temperatures, however, will not give protection against rats and mice.

The bean weevil is a serious pest of stored beans. The eggs are laid in the field, being deposited on the pods by the adult beetle. During the fall, temperatures are usually relatively high and the weevil may do great damage to beans before cold weather comes even though they are stored under outside conditions. It is, therefore, quite necessary to treat the seed for weevil soon after it is harvested. Where the quantity is not large and the beans are not to be planted for a future crop, heating to 120°-145°F. for six hours will kill the weevil. Where large quantities of beans are to be stored, fumigation with carbon bisulfide is the more practical. This treatment impairs the germination very little if at all. One ounce of carbon bisulfide is used for every three bushels of seed. The seed must be in a tight container which may be closed tightly. The carbon bisulfide is poured on top of the seed, and the container closed for a period of 48 hours. Carbon bisulfide is highly inflammable; hence fire or sparks must be kept away from the liquid or its vapor.

Where access to cold storage facilities is had, storing beans at 25°F. for 12 hours will effectively rid them of weevil. This also will not impair germination.