Commercial Production of

Bush Snap Beans

in Oregon

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Snap Beans *in Oregon*

Summary of Production

Scientific name: *Phaseolus vulgaris.*

Varieties: Tendercrop, OSC lines of dwarf Blue Lake (trial stage), Puregold (wax), Early Puregold (wax), (see OSC Extension Leaflet, "Oregon Vegetable Varieties" for latest information).

Amount of seed per acre: About 60 pounds to 100 pounds depending on size of seed and percentage of germination. See table on seeding rates for bush snap beans in this bulletin.

Seed treatment: Seed should always be protected with fungicide (Arasan SF, Spergon, or Captan) plus insecticide (dieldrin, aldrin, or lindane). Buy treated seed.

Spacing: Between rows: 36″ to 38″ (36″ to 38″ for mechanical harvest). Between plants: 1½″ to 2″.

Time of planting: Spring—April 25 to June 1 depending on location. Fall—June 15 to July 15 depending on location.

Method of seeding: 2 to 4 row planter set to drop 23 to 34 seeds per yard when seed germination is 80%. The heavier seeding (minimum of 27 seeds per yard of row) is recommended if bush beans are to be harvested mechanically. Speed of seeding about 2 mph. Seeding rate in first few hundred feet of row should be checked by raising or removing the seed covering device on planter. Make count of seed dropped. Do not damage seed by rough handling. See table in this bulletin on seeding rates for bush snap beans.

Time of harvest: 50 to 65 days depending on variety and weather.

Irrigation: Most beneficial at time of flowering and/or when soil moisture is down to 50% available.

Fertilization:

Nitrogen (N): 50-100 pounds per acre
Phosphorus (P_2O_5): 50-120 pounds per acre
Potash (K_2O): 40-120 pounds per acre where needed

On soils that give a crop yield response to additional potash, a complete fertilizer that will supply 40 to 120 pounds of potash is recommended. Amounts of potash in excess of 60 pounds per acre should be broadcast before planting. The soil in each field should be tested first. Beans have a low tolerance and low requirement for boron. Fertilizer is applied in bands 3″ to 4″ deep and 2″ to the side of the seed row. Twenty to 40 pounds N is applied by irrigation or sidedressing when beans are in full bloom. For details see page 13 of this bulletin.

Nutrients removed by 4-ton crop: (Approximate—not to be used as guide to fertilization practices)

	N	P_2O_5	K_2O
Pods	60	15	40
Foliage	50	10	35
Total	110	25	75

Harvesting by machine: Notes on culture: Bean rows spaced 36" apart can be picked, but 38-inch spacing is somewhat better because it results in cleaner picking and fewer beans left on the ground.

Spacing of approximately 8 plants per foot of row is desirable because it tends to make the plants grow taller and less bushy. Ten seeds per foot of row should be sown when germination is 80%.

Notes on operation of mechanical picker: On 38-inch rows the driver must guide directly over the row. Pickup bars (skows) at ground level, and angle of reel to the height of bean plants in each field should be adjusted. The picking fingers at the leading end of the reel should be 4" down into the tops of bean vines, and the back end of the reel should be as close to the ground as possible. The operator should make these adjustments for each field within the first few yards of picking.

Reel speed of picker: 150 to 175 rpm.

Forward speed of picker: ¾ to 1 mph.

Capacity of mechanical picker: 3 to 5 acres per day.

Efficiency of mechanical picker: 75 to 85% of beans are harvested, depending somewhat upon variety of bean and type of growth.

Estimated cost per ton for harvesting by machine: $20 to $25 per ton. With additional improvements the picking cost per ton is expected to be less.

Storage of harvested beans (Emergency):

Temperature:	45° to 50° F.
Humidity:	85%
Time:	5 days

Ventilate to prevent "nesting"

Weed Control

Control of weeds which emerge when beans emerge

Chemical: Dinitro amine.

Spray mixture: 1 to 2 gallons of 3-pounds per gallon formulation (3 to 6 pounds active) in 30 or more gallons of water per acre.

Time of application: Immediately after planting if possible or at least before beans break through the soil. Cost may be reduced by using a band application over the row, sprayed on at time of seeding.

Caution: Spray only one time.

Control of annual grasses and broadleaf weeds

Chemical: Vegedex.

Spray mixture: 2 quarts of 4-pounds per gallon formulation (2 pounds active) in 30 or more gallons of water per acre. (Use 3 to 6 quarts if grass problem is severe.)

Time of application: Immediately after planting.

Caution: Spray only one time.

Chemical combination: Vegedex plus dinitro amine.

Spray mixture: 2 quarts of 4-pounds per gallon formulation (2 pounds active) of Vegedex plus 2 to 4 quarts of 3-pounds per gallon formulation (1½ to 3 pounds active) of dinitro amine in 30 or more gallons of water per acre.

Control of perennial grasses

Chemical: Eptam.

Spray mixture: For nutgrass—2

quarts of 6-pounds per gallon formulation (3 pounds active) in 30 or more gallons of water per acre. For quack grass—4 quarts of 6-pounds per gallon formulation (6 pounds active) in 30 or more gallons of water per acre.

Time of application: Before planting, spray Eptam and work it thoroughly into the soil by discing twice. Seed may be planted immediately.

Caution: Do not use on lima beans.

Control of weeds after the beans have emerged

Chemical: Dinitro amine.

Spray mixture: 2 to 6 quarts of 3-pounds per gallon formulation (1½ to 4½ pounds active) in 30 or more gallons of water per acre.

Time of application: When most of the beans have emerged to the "crook stage," that is, after the bean seedling has broken through the ground and before the stem has become erect.

Caution: Check the air temperature with a reliable thermometer. If the air temperature is 85°, or is expected to reach or exceed 85° within 24 hours following the application, then delay treatment.

Disease Control

Bean-sclerotinia disease (White Mold)

Cause: *Sclerotinia sclerotiorum,* a fungus. This organism lives during winter months as sclerotia, attached to old bean stems or directly in the soil. Sclerotia are moved about on plant materials, farm implements, irrigation water, and on seed. Infection occurs most frequently under cool, moist weather conditions. Other host plants include lettuce, carrots, parsnips, cabbage, and other crucifers and cucurbits.

Symptoms: Young infected plants show water-soaked spots on the stems or leaves. Older plants develop similar spots anywhere on stems, petioles, leaves, or pods. These spots are a white creamy mat-like fungus growth. Most infections occur near the ground. The fungus may also invade the pith of the main stem. Infected leaves turn yellow and wilt. Imbedded in the external fungus growth are compact sclerotia. These are at first white in color and later darken until they are black and hardened.

Control: (1) Deep plowing to bury sclerotia is beneficial. (2) Rotate crops where land permits for at least one year to escape sclerotia infection. This is of little value in concentrated bean areas due to widespread dispersion of spores through the air. (3) Apply fungicides. In fields where white mold has been a problem, the spray or dust applications should be started as soon as wet weather occurs. Some growers may profitably wait until the disease makes its first appearance, before applying fungicides. During wet weather apply a fungicide every seven days, especially to the lower half of the plants.

Sprays: Use Ziram at the rate of 1½ pounds in 100 gallons of water. Use Terraclor at the rate of 3 pounds active ingredient (PCNB) per acre. Terraclor may be combined with dinitro amine and applied after seeding. Apply

150-200 gallons of spray per acre for effective disease control.

Dusts: Use Ziram 3 pounds active per acre (40 pounds of 10% dust) or Terraclor 20% dust at the rate of 25 pounds per acre.

Residues: Ziram—if applied within 4 days of harvest, wash beans to remove residue. Terraclor—Do not apply after the first bloom. Do not feed the treated vines to livestock.

Root rot

Cause: *Fusarium* sp., fungi. Species of *Fusarium* live in the soil indefinitely, probably for many years. They are spread on infected bean straw and by soil water.

Symptoms: The plants are stunted and the leaves are yellowish and often drop early. Around the ground level and below, the main root may show a red discoloration later turning black and decaying. The infection seldom grows into tissue above the ground level. Small side roots are killed and above them secondary roots are developed which may also become infected and die. These secondary roots help to maintain the plant and assist in crop development.

Control: Plant in well-drained soil. Practice a long rotation with grass or grain crops intervening for 5 or 6 years. Shallow cultivation may be helpful. A good control measure is not known. Despite the widespread prevalence of the soil organisms, reasonably good crops are usually produced.

Seed rot and seedling blight

Cause: *Pythium* and *Rhizoctonia* sp., fungi. Both seed rot and seedling blight result from fungi which persist indefinitely in the soil.

Symptoms: Seed decay or a rotting and damping-off of the young seedling plants. Wilting and death of the seedlings follows.

Control: Treat seed as described in text.

Bean rust

Cause: *Uromyces phaseoli* var. *typica,* a fungus.

Symptoms: Initial symptoms appear on lower surface of leaves as small, white, raised spots. Later rust colored spots appear on pods and leaves.

Control: (1) Cut down and disc vines as soon as last picking is completed. (2) Dust with sulfur (325 mesh or finer). Start dusting as soon as the first leaves begin to form. Continue dusting at one-week intervals until the first blossoms appear. Five to seven applications may be necessary. (It is not advisable to dust after any pods have formed since some canneries have experienced difficulties when using products bearing sulfur.) The critical time to dust with sulfur is early in the season to prevent the white spore stage. At this time the plant needs protection only from an occasional spore, but once the brown spore stage has started, plants need constant protection against innumerable spores.

Pests	Description and damage	Control (Dosages refer to actual amount of toxicant per acre)	Tolerance ppm.	*Restrictions* (Interval between last application and harvest)
Bean aphid *Aphis fabae* Scop.	Black plant louse which colonizes on leaves and pods. May occur early in season but most common found in late summer.	Dibrom—2 lbs.	N.R.†	4 days—Washington and Oregon only
		Malathion—1.75 lbs.	8	1 day
		Diazinon—0.5 lb. spray 1.4 lbs. dust	0.75	7 days
		Trithion—0.75 lb. as spray 1.2 lbs. as dust	0.8	7 days—Do not feed*
		TEPP—0.4 lb. as spray 1 lb. as dust	0	3 days
		Parathion—0.5 lb.	1	15 days
		Phosdrin—0.5 lb.	0.25	1 day
		Nicotine sulfate—1 lb.	2	3 days
Beet armyworm *Laphygma exigua* (Hbn.)	Full grown larva 1¼ inches long, greenish with a broad, dark, lateral band, edged with a narrow white line. Larvae tend to defoliate pigweed and later migrate to beans.	DDT—2 lbs.	7	7 days—Do not feed*
		Malathion—1.75 lbs.	8	1 day
Painted-lady or thistle butterfly *Vanessa cardui* (L.)	Spiny caterpillars, dull brown to black with pale yellow stripe on each side. Caterpillars feed mostly on thistle, but will sometimes move to beans.	DDT—2 lbs.	7	7 days—Do not feed*
Garden symphylid	Small white centipede-like animal.	Parathion—5 lbs. or soil fumigant.	N.R.†	
Nitidulid beetle *Meligethes nigrescens* Stephens	Small, black beetle which infests blossoms. May cause blossom drop. Economic level averages 6 beetles per blossom.	Dibrom—2 lbs.	N.R.†	4 days—Washington and Oregon only
		DDT—2 lbs.	7	7 days—Do not feed*
		Methoxychlor—2 lbs.	14	3 days—Do not feed treated vines to livestock
		Malathion—1.75 lbs.	8	1 day
		Diazinon—0.5 lb. as spray 1.4 lbs. as dust	0.75	7 days
		TEPP—0.4 lb. as spray 1 lb. as dust	0	3 days

INSECT CONTROL SUMMARY—(*Continued*)

Pests	Description and damage	Control (Dosages refer to actual amount of toxicant per acre)	Tolerance ppm.	*Restrictions* (Interval between last application and harvest)
Pea leaf weevil *Sitona lineata* (L.)	Adults small, grayish-brown weevils about $\frac{1}{8}$ inch long. May appear on beans in late summer in Willamette Valley. To date not serious on beans.	Malathion—1.75 lbs. Methoxychlor—2 lbs.	8 14	1 day 3 days. Do not feed treated vines to livestock.
Western spotted cucumber beetle *Diabrotica undecimpunctata* Mann.	Yellowish-green, black-spotted beetle common to western Oregon. Adults attack and feed on seedlings, foliage and pods.	DDT—2 lbs. Methoxychlor—2 lbs. Sevin‡—2 lbs. *For light infestations:* Malathion—1.75 lbs. TEPP—0.4 lb. as spray 1 lb. as dust	7 14 10 8 0	7 days—Do not feed† 3 days—Do not feed treated vines to livestock No time limitation Do not feed* 1 day 3 days
Wireworms *Limonius* spp.	Brown, jointed larvae of click beetles. Kill young plants, weaken older ones.	Preplanting soil treatment of: Aldrin—2 to 3 lbs. Dieldrin—2 to 3 lbs. DDT—20 lbs. *For light infestations:* Aldrin, Dieldrin, or lindane seed treatments with Thiram will provide crop protection. (See Seed-corn maggot.)	 0 0 7	 No restrictions if used as directed
Seed-corn maggot *Hylemya cilicrura* (Rond.)	White larvae of fly, similar to the cabbage maggot. Attack germinating seeds and may destroy planting. Generally abundant during cool wet weather.	*Seed treatments:* Aldrin Dieldrin Lindane $\frac{1}{3}$ oz. (75% W.P.) plus Thiram $1\frac{1}{2}$ oz. (75% W.P.) per 100 lbs. of seed. *Preplanting soil treatment of:* Aldrin—2 to 3 lbs. Dieldrin—2 to 3 lbs. will reduce or prevent damage	 0 0 N.R.† N.R.† 0	*Seed treatment only:* Do not use treated seed for food or feed* No restrictions if used as preplanting treatment

INSECT CONTROL SUMMARY—(*Concluded*)

Pests	Description and damage	Control (Dosages refer to actual amount of toxicant per acre)	Tolerance ppm.	*Restrictions* (Interval between last application and harvest)
Gray Garden Slug	Small molluscs, common to western Oregon. Most destructive to crops in early spring.	3% metaldehyde-calcium arsenate bait. 10 lbs. Repeat applications frequently. Avoid baiting during periods of heavy rainfall.	N.R.	Spread baits lightly on ground around plants. Avoid contamination of crop. See also "Oregon Insect Control Handbook."
Spider Mites *Tetranychus* spp.	Tiny spider-like animals, located on undersides of foliage. Feed on plant juices and cause yellowing and browning of leaves. Not usually a problem in western Oregon.	Kelthane*—0.6 lb. as spray 1.5 lbs. as dust	5	7 days—Do not feed*
		Trithion—0.75 lb. as spray 1.2 lbs. as dust	0.8	7 days—Do not feed*
		Diazinon*—0.5 lb. as spray 1.4 lbs. as dust	0.75	7 days
		Malathion—1.75 lbs.	8	1 day
		Parathion—0.5 lb.	1	15 days

* Do not feed crop or crop residue to dairy, poultry, or meat animals.
† No recommendation.
‡ Pesticide has Federal registration but data on effectiveness under Oregon conditions has not been determined by Oregon State College.

Details of Production

Soils and Soil Preparation

Bush snap beans may be grown successfully on well-drained soils varying in texture from light sandy loams to heavier silt and clay loams.

For early market crops light soils are preferred.

For late spring or summer, or for those grown for processing, any of these soils are used.

Soil preparation should be thorough and should leave the seed bed smooth and firm but not packed. It is impossible to do a satisfactory job of planting if the seed bed is not in good condition.

Variety and Seed Source

Varieties should be chosen with regard to the preferences of the buyer, whether fresh market or processor. It should be a variety known to be adapted to the locality, capable of producing good yields, and acceptable quality. The variety picture changes constantly. Growers should keep informed on results of the latest variety tests and recommendations. Preferred, green-podded varieties at the present include: Wade, Tendercrop, certain OSC lines (in trial stage) as well as the yellow-podded (wax) variety Puregold and Early Puregold. None are entirely satisfactory for growing for processing at present. Certified, western-grown seed should be used for planting to avoid troubles from bacterial blights, viruses, and other bean diseases. These can be kept under control by using disease-free seed produced in arid regions. Seed grown the previous season is recommended, especially for the early crop. One-year-old seed can be used with good results for the late spring or summer plantings after the soil is warm.

Seed Treatment

Before planting bean seeds, protect them from maggot injury by coating them with a thin slurry, or paste, that contains an insecticide and a fungicide. The beans retain the coating after they are planted, and maggots that attack them are killed by contact with the insecticide. The fungicide is necessary to protect the beans from pre-emergence attack from diseases. It it customary for seed to be purchased already treated. The following information is for those who wish to treat their own seed. Aldrin, dieldrin, or lindane are suitable insecticides. A finely ground, solvent-free wettable powder of 75% strength is used. A lower strength might not be effective. The recommended fungicides are arasan SF, spergon, or captan. The fungicides are available as dusts or as wettable powders especially prepared for slurry.

By following the recommendations given here, less than one ounce of chemical per acre will reach the soil. This amount of insecticide in the soil

does not give off-flavor to bean crops, or bean products.

Preparing the slurry

The stock supply of slurry is prepared by mixing the insecticide and the fungicide with water. To prepare slurry in an amount sufficient to treat 50 pounds of seed, $\frac{1}{3}$ ounce (4 level teaspoonfuls) of the insecticide, $1\frac{1}{2}$ ounces (9 level tablespoonfuls) of the fungicide, and 8 fluid ounces (1 cupful) of water should be mixed and stirred thoroughly. It should stand about 10 minutes before using.

Treating the seed

Seed and slurry are mixed in a container for slurry treatment. In treating small quantity of seed, a smooth container that can be closed tightly and rolled and tumbled, such as a fruit jar or friction-top can, should be used. The container is only half filled with seed in each operation. Several operations, with a new batch of seed each time, may be necessary.

One teaspoonful of slurry per pound of seed should be used. In treating the first batch of seed, the amount of slurry is increased about 10% to com-

Mechanical bush bean harvesters may be adapted to pick into sacks or tote bins. The convenience of tote bins makes them preferred by growers and processors. Machine will pick 3 to 5 acres per day.

pensate for the slurry that will stick to the inside of the container. The slurry should be sprinkled over the seed, the container closed, then rolled and tumbled until the seed is smoothly coated. The treated seed should not be left in the container, but put in a cloth sack to dry.

If as much as 1,000 pounds of bean seed each season is being treated, the purchase of a slurry-treating machine will be helpful. It regulates the flow of seed and slurry, causing the seed to receive a uniform coating. Six ounces of the insecticide mixed with 1½ pounds of the fungicide, and 1 gallon of water, will coat about 900 pounds of bean seed when used in the machine. The manufacturer of the machine furnishes directions for using it.

A clean cement mixer may be used as a substitute for a slurry-treating machine. The same proportions indicated in the reference to slurry-treating machines are used, measuring out 1 pint of slurry for each 100 pounds of seed. The mixer should not turn longer than is necessary to coat the seed, in order to avoid damage to the seed.

Handling treated seed

Moist seed will not feed properly through the planter. The seed is dried at least 1 hour before planting. It is not necessary to plant the seed the same day it is treated, but it may be set aside for several days. After it has dried, the seed is placed in bags made of heavy paper or closely woven cloth; such bags keep the powder from sifting out.

Custom treating

In some states seedsmen or others who wish to do custom treating of seed are required to obtain a license. Local agricultural authorities should be asked about licensing before doing any custom treating.

If treated seed is offered for sale, each bag must carry a label giving the name of the insecticide used and stating that the seed is unfit for food or feed purposes.

Planting

Snap beans are injured or killed by freezing weather and therefore are not usually planted until danger of frost is past. Home gardeners and growers producing beans for the early fresh market often take chances on frost damage by planting prior to the last killing frost. They are normally planted in rows about 3′ apart. The planting rate should result in an average of 6 to 10 plants per foot of row. This will require from 1 to 2 bushels of seed per acre depending on the size of seed and the percentage of germination (see chart in this bulletin). Seed may be planted ¾″ to 1½″ deep on heavy soils and 1½″ to 2″ deep on light soils. Where moisture is available, shallow planting is desirable for quick emergence.

The planting equipment should be checked in the field to insure that it is doing the right kind of job; that the right amount of seed is being sown, that they are placed at the correct depth, and that fertilizer is properly placed in relation to the seed. This is generally done by scratching in the row to uncover seed and fertilizer, or by raising or removing the seed-covering device on the planter for the first 100′ or so of planting. The planter

should be operated at a speed of about 2 mph. Operating at too fast a speed results in variable seed spacing and in spotty stands. The importance of careful soil preparation in permitting proper planting cannot be over-emphasized. Seeding should be done by experienced hands.

Fertilization

Fertilizer recommendations for bush snap beans in Oregon are generally 50 to 100 pounds of N, 50 to 120 pounds of P_2O_5, and 40 to 120 pounds of K_2O per acre. For a better guide to fertilizer needs the results of a soil test should be obtained from each field. Soil samples should be sent to the Oregon State College Soil Testing Laboratory through your county extension agent.

No more than 800 pounds of mixed fertilizer should be applied in bands with the bean planter, or fertilizer injury to the seedlings is likely to occur. Beans are very susceptible to "fertilizer burn" from fertilizer too near the seed when moisture is limited, and particularly on light-textured soils. Fertilizer should not come in contact with bean seed. Fertilizer applied with the planter should be placed in bands 1½" to 2" on one side, or both sides, of the seeds and 3" to 4" deep. The planting equipment should be adjusted and checked to make sure it is being placed in this manner. If more than 800 pounds of mixed fertilizer per acre is to be applied, the remainder should be plowed down or side-dressed. An application of 20 to 40 pounds of nitrogen per acre is desirable when the plants are about four weeks old, or at the time of flowering.

Cultivation and Weed Control

Cultivation of snap beans should be shallow, especially at any time past the seedling stage. A large part of the roots are in the top 6" of the soil. Cultivation 2" or 3" deep near the plants can do serious damage with consequent reduction in yield. Weeds should be kept under control by herbicides and shallow cultivation. If the beans are to be harvested by machine, all cultivations should be kept flat, so as not to ridge the soil. Excellent results with chemical weed control are possible by the application of 3 to 6 pounds of dinitro per acre as a spray immediately after seeding. For additional information contact your county extension agent.

Bean plants are unusually sensitive to applications of 2,4-D. Mild to severe injuries to beans have been reported where fields, roadsides, and rights-of-way adjacent to the bean plantings were treated with volatile 2,4-D.

Irrigation

The most critical period in the soil moisture supply is from the time pods are forming until harvest. As a rule-of-thumb, 1" to 1½" of water should be applied every 7 days after the blossom buds are formed. Moisture stakes may be used to determine when and how long to irrigate. Thorough irrigations that wet the soil to field capacity are better than light sprinklings.

Insect Control

Several insects can cause considerable damage to snap beans. The 11-spotted beetle may inflict some early injuries by chewing the tender leaves of the young plants soon after they come through the ground. Later on this insect eats leaves and pods. Injury to pods is sometimes quite serious.

Nitidulids, small black beetles, frequently infest bean blossoms and may cause blossom drop. Critical level of infestation is six beetles per blossom.

Black aphids are sometimes very injurious to beans. Corrective measures should be taken as soon as aphids are detected.

Spider mites are sometimes present in bean fields but seldom require control measures in Western Oregon. Malathion, Phosdrin, or TEPP as suggested for aphid control may be used if control of spider mites is indicated.

Symphylids are small, white animals similar in appearance to garden centipedes. They have caused considerable damage to beans in the past and seem to be increasing both in numbers and in the areas affected. Their underground habits make them difficult to control. Currently available soil fumigants or parathion should be used in badly infested fields. The yield response to thorough symphylid control may be greater than the response to fertilizer.

See also Seed Treatment and Blossom Drop. Further details concerning insect control are available from county extension agents. Special consideration should be given to the time interval between application of the insecticide and harvesting the crop so as to comply with the provisions of the Miller Amendment to the Food, Drug, and Cosmetic Act.

Slugs are molluscs, closely related to snails but with no external shell. They are one of the most common and persistent pests of forage crops, vegetables, and home gardens in Western Oregon. They are active above ground during cool, wet periods at any time of year. Little activity occurs during periods of freezing or hot weather. Our most economically important species is the small, gray garden slug; but the black greenhouse slug, the large spotted garden slug, and more recently, the brick-colored European slug are important in some areas. Slugs are hermaphrodites; each individual is capable of laying eggs. The small, round, pearl-like eggs, often laid in clusters of a half-dozen or more in sheltered cavities near the soil surface, hatch within two weeks or a month or may overwinter. The greatest egg-laying activity occurs in early spring and after the first fall rains. The gray garden slugs are reported as living two or three years, but it appears to be more common for them to live one year.

When slugs are feeding above ground they can be controlled by applications of bait containing about 3% metaldehyde and usually including calcium arsenate, used at the rate of about 10 pounds bait per acre. Metaldehyde dust formulations should not be applied to the surface of the ground or to foliage where the slugs are feeding. Metaldehyde volatilizes rapidly and breaks down quickly in contact with moist soil. It is more residual in action when combined in a bait.

Commonly used dinitro herbicides will kill many slugs if the pests are contacted by the spray or crawl over the residue shortly after application. Calcium cyanamid is often used to

break down cover crops. If this material is applied at the rate of 300 or more pounds per acre several days before plowing so that it is partially dissolved by rains or heavy dew, it is effective in reducing slug populations. As much as 80% control has been obtained in this manner. (Calcium cyanamid is 20 to 22% nitrogen; it is toxic to plants if it comes in direct contact with leaves, seeds, or roots before it has broken down into usable forms of nitrogen. Breakdown requires two weeks in moist soil.)

Slug control should be viewed as a year-round practice. Special attention should be given to fall baiting of cover crops. Bait applied soon after the first fall rains will kill many slugs before they can lay eggs. Where the cover crop is such that it will provide luxuriant growth by the following spring, it also provides conditions favorable to slug development and slug damage to crops following the cover crop. Treatments in the spring with baits or other materials is important in keeping slug populations at a low level.

Disease Control

Virus diseases frequently cause severe losses in beans. Common mosaic is seedborne and the use of disease-free seed is essential for its control. Bean yellow mosaic is not seedborne, but is introduced from other crops by aphids. Beans should not be planted near plantings of clover, alfalfa, field peas, or gladiolus because these crops may serve as reservoirs or sources of virus. Bean varieties may be resistant to common mosaic but susceptible to yellow mosaic.

Bean rust is common in bean-growing areas when weather conditions are favorable for the development of the disease. It is a fungus disease which can infect most varieties of snap bean. While some varieties have proved somewhat resistant to this disease, the current varieties of beans grown commercially may be seriously affected. Control of bean rust in commercial acreages will depend on: (1) discing vines as soon as the last picking is made to prevent the formation of the overwintering stage, (2) dusting with sulfur at weekly intervals if rust appears on the foliage. Dusting with sulfur should begin as soon as the first leaves begin to form and should continue until the first pods are set.

White mold (Sclerotinia) may cause severe crop losses in the Willamette Valley, especially in wet growing seasons. The fungus which survives as sclerotia (hard black fungus bodies $\frac{1}{8}$" to $\frac{1}{4}$" long) in the soil may attack the young plant stems directly or produce mushroom-like growths which liberate spores to cause infection of all above-ground parts of the bean plant. Many of the infections occur through blossom petals sticking to leaves, stems, and pods. Water soaked spots appear soon after infection, followed by the development of a white creamy mat-like fungus growth. Rotting of the stem at ground level (a common symptom) is followed by yellowing of the leaves and death of the plant. Deep plowing to bury sclerotia, and crop rotation are the best preventive measures. Spraying or dusting with Ziram or Terraclor (PCNB) will give practical control of the disease.

Blossom Drop and Malformed Pods

It is generally recognized that pollination of beans may be seriously affected by high temperature (90° or above). Bean blossoms drop off because of imperfect pollination due to the influence of warm weather and possibly other factors on the production or germination and growth of the pollen. If the plants have a good reserve of soil moisture and good leaf growth they seem to be troubled less with blossom drop than otherwise. Good results have occasionally been obtained in small trials from the use of the growth regulator CLPA (parachlorophenoxyacetic acid) at the rate of 1½ grams per acre applied as a spray or dust when the plants are in full bloom. Other growth regulators have been tested in attempts to reduce blossom drop in snap beans, but at present none show sufficient promise to be recommended.

Some snap bean pods are "polliwog" shaped instead of being straight, well-filled, and uniform from stem to spur. In most misshapen pods only half or one-third of the pod is filled with seed. Normal pods have 5 or 6 seeds. Incomplete fertilization of the bean flower is one cause of malformed pods.

Where summer temperatures are high it has been found that pods with only one or two beans in them result from flowers pollinated by pollen grains low in starch. Such pollen is frequently sterile.

The nitidulid or black pollen beetle can cause blossom drop when infestations are heavy. An average of 6 to 8 beetles per blossom seems to be the "maximum safe" level of infestation. The insects show up every year usually between mid-July and mid-August, but in some seasons are not sufficiently abundant to warrant special control measures. The number of beetles in 25 to 50 blossoms should be counted to determine the average infestation. Control of heavy migrations has not been possible. Medium infestations (8 or so per blossom) can be reduced by any of the insecticides used for aphids or the Diabrotica (11-spotted beetle) control (i.e., DDT, Methoxychlor, Malathion, Diazinon, Dibrom, TEPP).

Harvesting and Yields

Bush snap beans are usually harvested by hand with two to five pickings being made four to five days apart. Beans should not be allowed to become over-mature or excessively fibrous before being picked. All pods of suitable size should be removed at each picking. If the mechanical harvester is used, only one picking can be made with some sacrifice in yield. In some cases, however, one or more pickings may be made by hand and the final one by machine.

The quality and market value of snap beans are very largely dependent upon the time of picking and the development of the pods. It is important to pick beans before the pods or seeds become large. Some varieties have a slower rate of seed development than others. It is necessary to pick bean pods carefully so as to pick those that have reached sufficient development, but to leave on the vines those pods which are not yet large enough to be harvested. In this way the percentage

of lower grades of beans may be reduced to a minimum. When instructing pickers, careful and clean picking should be emphasized to insure high quality and a better grade.

Following are the bean pod dimensions in fractions of an inch for the various field grades: No. 1 grade, 14½/64 to 21/64; No. 2 grade, 21, 22, 23/64; No. 3 grade, 24, 25, 26/64; and No. 4 grade, 27/64 or more. The percentages of grades in a field will vary considerably with the season, variety, soil fertility, moisture conditions, supervision of pickers, and the availability of labor to harvest the crop.

Grades and Grading

Relationship of Pod Sieve-Size to Grades of Raw Snap Beans

Canner's grade	*Sieve size*	*Pod thickness (inch)*
1	1	less than 14.5/64
1	2	14.5/64 to 18.5/64
1	3	18.5/64 to 21.0/64
2	4	21.0/64 to 24.0/64
3	5	24.0/64 to 27.0/64
4	6	27.0/64
cull	7 and over	over 27.0/64

Relationship of Percent Seed to the Grades of Raw Snap Beans

Grade	*% Seed*
Fancy	0-10
Extra Standard	11-18
Standard	19-25

Procedure to Determine Percent Seed of Raw Snap Beans

1. Collect a small representative sample of raw beans. Weigh the beans.
2. Remove seeds from pods. Weigh seeds and pods separately on a triple beam balance to within a tenth of a gram.
3. Calculate percent seed by dividing weight of seed by weight of original sample and multiply by 100.

$$\text{Percent seed} = \frac{\text{weight of seed}}{\text{weight of sample}} \times 100$$

All Green and Wax Beans: Total Harvest (Thousands of Acres)

Crop year	U. S. total				Acreage for processing							
	Fresh mkt.	Freezing	For canning	Processing	N. Y.	Pa.	Mich.	Wisc.	Md.	Fla.	Tex.	Ore.
1947	197.8	*	*	104.4	19.0	4.0	6.8	10.6	8.3	7.1	7.6	4.7
1948	192.2	*	*	106.4	23.5	2.6	5.8	9.7	11.0	7.1	6.0	4.9
1949	188.4	*	*	126.4	25.2	3.9	7.1	13.0	13.0	6.7	8.6	6.6
1950	185.9	*	*	121.2	24.4	3.7	6.4	12.0	10.3	7.5	7.2	6.6
1951	184.2	*	*	120.5	26.0	4.1	6.3	12.0	9.5	10.0	2.7	7.4
1952	161.4	*	*	114.9	28.5	5.0	6.3	12.8	9.4	7.2	4.2	6.6
1953	151.0	*	*	149.0	32.8	7.0	7.0	13.7	12.7	18.7	10.6	7.6
1954	152.8	34.5	119.4	153.9	35.5	6.0	8.0	16.0	12.3	13.6	9.7	9.4
1955	152.4	31.6	102.9	134.5	29.6	5.0	6.3	15.1	9.8	11.2	7.0	10.5
1956	136.0	32.0	105.8	137.8	33.4	5.1	6.5	16.6	10.1	8.9	8.0	10.6
1957	132.4	33.3	118.3	151.6	37.3	6.1	6.6	19.3	9.4	12.5	7.5	10.8
1958	128.2	34.8	116.2	151.0	34.0	5.8	7.0	21.7	10.0	8.2	9.2	10.7

* Years for which data are not available.

All Green and Wax Beans: Yield Per Acre (Tons)

Crop year	U. S. average				Yield per acre for processing							
	Fresh mkt.	Freezing	For canning	Processing	N. Y.	Pa.	Mich.	Wisc.	Md.	Fla.	Tex.	Ore.
1947	1.42	*	*	1.66	1.4	2.3	0.6	1.0	1.4	1.2	1.4	7.0
1948	1.50	*	*	1.81	1.4	1.9	1.3	1.4	1.3	1.5	1.2	7.0
1949	1.55	*	*	2.09	1.8	1.7	1.5	1.7	1.4	1.5	1.3	8.2
1950	1.50	*	*	2.18	1.7	2.2	1.5	1.5	1.6	1.5	1.5	8.1
1951	1.60	*	*	2.27	1.8	2.1	1.6	1.6	1.7	1.7	1.5	8.0
1952	1.55	*	*	2.09	1.8	1.8	1.5	1.7	1.6	1.5	1.3	7.9
1953	1.70	*	*	2.14	1.8	1.8	1.8	1.7	1.7	1.7	1.4	7.2
1954	1.70	2.38	2.21	2.25	1.6	1.8	1.9	1.6	1.7	1.8	1.7	7.6
1955	1.80	2.33	2.25	2.27	1.5	1.8	1.1	1.3	1.5	1.9	1.7	7.8
1956	1.70	2.59	2.42	2.46	2.0	2.4	2.0	1.7	1.7	1.7	1.2	7.3
1957	1.85	2.56	2.31	2.37	1.8	1.9	1.5	1.5	1.5	1.7	1.1	8.1
1958	1.75	2.80	2.30	2.40	1.6	2.3	1.6	1.4	1.7	1.8	2.0	8.3

* Years for which data are not available.

All Green and Wax Beans: Total Production (Thousands of Tons)

Crop year	U. S. total				Production for processing							
	Fresh mkt.	Freezing	For canning	Processing	N. Y.	Pa.	Mich.	Wisc.	Md.	Fla.	Tex.	Ore.
1947	318.0	*	*	173.1	26.6	9.2	4.1	10.6	11.6	8.8	10.6	32.9
1948	316.9	*	*	193.0	32.9	4.9	7.5	13.6	14.3	10.6	7.2	34.3
1949	312.2	*	*	264.2	45.4	6.6	10.6	22.1	18.2	10.2	11.2	54.1
1950	302.4	*	*	263.8	41.5	8.1	9.6	18.0	16.5	11.0	10.8	53.5
1951	316.4	*	*	273.5	46.8	8.6	10.1	19.2	16.2	16.8	4.0	59.0
1952	265.2	*	*	240.5	51.3	9.0	9.4	21.8	15.0	10.5	5.5	51.7
1953	271.0	*	*	319.4	59.0	12.6	12.6	23.3	21.6	32.3	14.8	55.1
1954	270.4	82.1	264.3	346.4	56.8	10.8	15.2	25.6	20.9	23.9	16.5	71.4
1955	284.3	73.7	232.0	305.7	44.4	9.0	6.9	19.6	14.7	21.0	11.9	81.9
1956	241.5	83.0	255.6	338.6	66.8	12.2	13.0	28.2	17.2	15.1	9.6	77.4
1957	252.9	85.1	273.8	358.9	67.1	11.6	9.9	29.0	14.1	21.9	8.2	87.5
1958	225.5	96.7	269.1	365.8	54.4	13.3	11.2	30.4	17.0	15.1	18.4	88.8

* Years for which data are not available.

All Green and Wax Beans: Season Average Price Received by Growers (Dollars Per Ton)

Crop year	U. S. average				Price per ton for processing							
	Fresh mkt.	Freezing	For canning	Processing	N. Y.	Pa.	Mich.	Wisc.	Md.	Fla.	Tex.	Ore.
1947	144.00	*	*	103.73	108.10	96.80	108.30	104.80	83.10	102.40	72.50	129.70
1948	162.67	*	*	122.22	136.70	103.10	110.30	122.50	104.00	103.70	80.00	131.70
1949	146.80	*	*	111.70	119.60	101.70	119.60	110.50	90.10	109.00	76.00	134.30
1950	150.60	*	*	106.40	118.60	95.20	106.70	114.80	86.60	100.40	80.00	125.70
1951	162.60	*	*	113.50	121.60	111.10	109.00	114.50	99.40	102.60	90.00	124.70
1952	184.60	*	*	121.20	125.60	124.20	114.20	114.40	98.60	114.80	82.00	121.50
1953	181.60	*	*	124.70	128.30	134.50	115.00	114.20	112.90	135.90	85.00	131.10
1954	163.40	128.50	116.70	119.50	121.40	127.80	111.80	114.30	109.00	108.80	90.00	133.10
1955	158.20	118.30	108.90	111.10	110.60	122.40	105.30	108.00	98.30	95.00	82.00	126.30
1956	183.20	126.90	116.40	119.00	125.00	121.80	108.00	105.10	105.60	115.90	82.00	128.20
1957	181.00	123.20	116.60	118.20	111.60	126.30	111.60	106.40	104.20	127.90	85.00	131.80
1958	157.80	122.20	107.50	111.40	105.00	110.40	101.40	91.20	102.50	118.20	92.50	129.20

* Years for which data are not available.

Seeding Rates for Bush Snap Beans

THE POUNDS OF SNAP BEAN SEED PER ACRE REQUIRED TO OBTAIN SIX PLANTS PER FOOT AS DETERMINED BY THE AVERAGE NUMBER OF SEED PER POUND AND PERCENT GERMINATION.*

Avg. No. Seed /Lb.	*Percent Germination*								
	100	95	90	85	80	75	70	65	60
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
1000	87	92	96	100	105	109	113	118	122
1020	85	90	94	98	103	107	111	115	120
1040	84	88	92	96	101	105	109	113	117
1060	82	86	90	95	99	103	107	111	115
1080	81	85	89	93	97	101	105	109	113
1100	79	83	87	91	95	99	103	107	111
1120	78	82	86	90	93	97	101	105	109
1140	76	80	84	88	92	95	99	103	107
1160	75	79	83	86	90	94	98	101	105
1180	74	78	81	85	89	92	96	100	103
1200	73	76	80	84	87	91	94	98	102
1220	71	75	79	82	86	89	93	96	100
1240	70	74	77	81	84	88	91	95	98
1260	69	73	76	79	83	86	90	93	97
1280	68	71	75	78	82	85	89	92	95
1300	67	70	74	77	80	84	87	90	94
1320	66	69	73	76	79	83	86	89	92
1340	65	68	72	75	78	81	85	88	91
1360	64	67	71	74	77	80	83	86	90
1380	63	66	69	73	76	79	82	85	88
1400	62	65	68	72	75	78	81	84	87
1420	61	65	68	71	74	77	80	83	86
1440	60	64	67	70	73	76	79	82	85
1460	60	63	66	69	72	75	78	81	84
1480	59	62	65	68	71	74	77	80	83
1500	58	61	64	67	70	73	76	78	81
1520	57	60	63	66	69	72	75	77	80
1540	57	59	62	65	68	71	74	76	79
1560	56	59	61	64	67	70	73	75	78
1580	55	58	61	63	66	69	72	74	77
1600	54	57	60	63	65	68	71	73	76
1620	54	57	59	62	65	67	70	73	75
1640	53	56	58	61	64	66	69	72	74
1660	52	55	58	60	63	65	68	71	74
1680	52	55	57	60	62	65	68	70	73
1700	51	54	56	59	61	64	67	69	72
1720	51	53	56	58	61	63	66	68	71
1740	50	53	55	58	60	63	65	68	70
1760	49	52	54	57	59	62	64	67	69
1780	49	51	54	56	59	61	64	66	69
1800	48	51	53	56	58	61	63	65	68
1820	48	50	53	55	58	60	62	65	67
1840	47	50	52	54	57	59	62	64	66

* Above rates for rows spaced 3 feet apart and 6 plants per foot.
For seeding rates giving 7 plants per foot multiply above rates by 1.17.
For seeding rates giving 8 plants per foot multiply above rates by 1.34.
For seeding rates giving 9 plants per foot multiply above rates by 1.51.