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Dry bean production practices in Colorado

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Quick Facts

- Dry edible beans can be produced in most parts of Colorado under dryland or irrigated conditions.
- As a legume, beans fit well into a rotation pattern with corn, barley, wheat, alfalfa and other crops.
- Beans have relatively low annual water and fertility requirements compared to other crops, which provides the farm operator with more flexibility for cropping programs.
- Beans are affected by a number of weed, disease and insect pests that can reduce yields.

The dry edible bean is an important component of Colorado's agriculture. Annual production has ranged from 85,000 to 155,000 tons during recent years with a market value of $40 to 80 million. More than half of the commercial acreage is irrigated and concentrated in eastern and central Colorado. The dryland acreage is located principally in the southwest. Certified bean seed production essentially is limited to the irrigated and dryland areas of the semi-arid western slope region. Average yields (principally pinto beans) have varied from 300 to 500 pounds per acre under dryland production to 1400 to 3000 pounds per acre under irrigated production.

This fact sheet summarizes production practices and pest management strategies utilized by Colorado dry bean producers. Additional information and other publications, such as the Colorado Dry Bean Production and IPM Bulletin 548A are available from county Cooperative Extension offices, Colorado Agricultural Experiment Station research centers and/or bean elevators.

Agronomic Practices

Crop Rotation

Irrigated dry bean production should include a three- to four-year rotation with crops such as alfalfa, corn, wheat, barley or vegetables. Beans should not be planted after potatoes or sugar beets if either crop was affected by rhizoctonia root and crown rots, or after irrigated sunflowers due to white mold susceptibility in both crops (and soybeans). Likewise, a wheat rotation can tie up soil nitrogen and aggravate fusarium root rot unless the wheat straw is well-decomposed before bean planting.

Dryland beans should be included in a three-year rotation with wheat, sunflower or grain sorghum. A year fallow period commonly precedes the bean crop. Continuous cropping to beans encourages the buildup of disease-producing organisms and insect pests that can damage the crop.

Market Types and Varieties

Traditionally Colorado has grown pinto beans, but has diversified into other bean types during recent years. Market types are classified by seed type; whereas varieties vary according to maturity (90 to 110 days), reactions to plant diseases and insect pests, nutrient deficiencies, herbicide toxicities and environmental stresses. The degrees of

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response to these factors depend upon the variety and production system utilized. Varieties vary in their growth habits from the vine (type III), to an upright vine (type II) to a true bush (type I), each of which responds differently to production inputs such as row spacing, planting rates and fertilizer.

Some pinto varieties grown under irrigation in Colorado include U.I. 114, U.I. 126 and U.I. 129; Olathe, Bill Z, RS 101, Othello, Cinnabar, Flint and RB 84354. Dryland varieties include San Juan Select and Cahone. Great Northern varieties include U.I. 59, Tara, Harris, Ivory, Beryl, Sapphire and Marquis. The most commonly grown small white is Aurora, and navy is Fleetwood.

Other market types successfully grown in Colorado include red kidneys (Sacramento Light Red, Isabella and Auburn-RB 83360) and pinks (Harold, Victor and Viva). Additional varietal testing is being conducted with other market classes such as small red (U.I. 36) and black (U.I. 906, Black Midnight) beans.

Planting Date and Rate

Dry beans should be planted in a firm but not compacted seedbed between May 25 and June 20 in Colorado. Avoid planting later unless short-season varieties become available. They may be adversely affected by high temperature during flowering (greater than 95°F), late season disease exposure or early fall frost. It is important to plant high quality certified seed to reduce infection from seed-borne pathogens. Seed should be treated with a fungicide to reduce seed rot, with a bactericide to reduce bacterial blight contamination and with an insecticide to reduce soil insect damage. Beans should be planted about 2 inches deep after danger of late spring frost and when the soil temperature reaches 60°F. Dryland moisture conditions may dictate deeper planting, however, depths in excess of 4 inches should be avoided.

Upright vine and bush types require at least 10 to 15 percent more seed and will yield comparably per unit area under narrow row widths (if the field has no history of severe white mold or root rot). Dryland conditions usually require 10 to 30 pounds per acre in 30- to 36-inch rows (1 seed per foot).

Planting rates depend on factors such as, plant growth habit (higher rates required for determinate or bush varieties), germination rate, row width and seed size (market class). Medium-sized pinto beans (1200 to 1400 seeds per pound) with vine growth habits generally are planted at 60 to 80 pounds per acre in 22- to 30-inch rows under irrigation, 4 to 5 seeds per foot in 30-inch rows. Large seeded beans (800 to 900 seeds per pound) such as kidneys should be seeded at 90 to 100 pounds per acre in 22- to 30- inch rows under irrigation. Small beans (more than 2900 seeds per pound) such as navies and blacks should be seeded at 28 to 32 pounds per acre in 22 to 30-inch rows in irrigated fields.

Fertility Requirements

Colorado's soils vary widely in fertility and other characteristics such as pH and salinity. Beans should not be planted in soil with a pH greater than 8 or salinity greater than 3 millimohs. Soil tests should be utilized to detect nutrient deficiency problems before planting when they can still be corrected with appropriate fertilizers. Prevention of nutrient stress is important because deficiency symptoms indicate the crop already has suffered damage.

As a legume, beans fix a portion of their nitrogen requirement from the atmosphere. Seed and soil inoculants *(Rhizobium leguminosarum* = nitrogen fixing bacteria) can fix some of the nitrogen used by the bean plant. Their effectiveness varies and use should depend upon recommendations and experiences from specific production areas. Inoculation is important on land where beans were not grown previously, lacking the necessary strain of nitrogen fixing bacteria specific for common beans.

The nitrogen requirement also can be supplied by residual soil nitrogen and by the decomposition of organic matter. Soils that contain low nitrate nitrogen levels (less than 10 ppm), as indicated by a soil test, may require 50 pounds per acre of nitrogen fertilizer. Additional nitrogen may be required if large amounts of organic matter, such as wheat straw, are present at the time of bean planting. Nitrogen usually is not required for dryland bean production, however, some fields may benefit from an application of 10 to 20 pounds per acre.

Phosphorus is an important element for all legume crops, however, beans usually are grown in soils with sufficient levels of residual phosphorus. Beans may respond to a preplant incorporation of 40 pounds per acre of P_2O_5 when grown in medium to low phosphorus soils. However, high phosphorus levels can be detrimental to the uptake of micronutrients such as zinc.

Many soils in eastern and southwestern Colorado are low in available zinc and iron. If soil tests indicate a deficiency, inorganic sources should be applied to the soil at 5 to 10 pounds Zn per acre broadcast or 5 pounds per acre banded next to the row. These rates can be reduced by one-half when zinc chelates are used. Ten pounds of nitrogen fertilizer per acre included with the band-applied zinc will increase uptake of zinc by plants. Foliar sprays can be applied during early growth stages at the rate of 0.5 percent zinc sulfate in 20 gallons of water plus wetting agent per acre. Zinc chelate at 1 to 2 pounds per acre also can be used, but always check the container label for the proper application rate to avoid burning of foliage.

Economical applications of iron can be made only as foliar sprays of 0.5 percent $FeSO_4$ plus wetting agent in 20 gallons of water per acre. Soil iron availability may be improved by including alfalfa in the cropping sequence and by applying manure to previous crops.

Weed Management

Dry bean productivity is affected by competition from weeds for moisture, nutrients and sunlight. Therefore, weed management is very important in Colorado and relies upon tillage practices and/or herbicides. When properly used, herbicides contribute greatly to the improvement of dry bean production. However, beans can be affected by excessive carryover of herbicides from previous crop cycles or herbicides that drift onto bean fields during the current season. Bean varieties and market classes differ in their tolerance to varying levels of certain herbicides.

The following herbicides have been used in this region: Eptam (EPTC), Treflan (Trifluralin), Lasso (Alachlor), Dual (Metolachlor), Basagran (Bentazon), Sonalan (Ethalfluralin), Poast (Sethoxydim) and Prowl (Pendimethalin) singly or in combination. Closely follow label directions for herbicide selection, application, incorporation, plant-back restrictions and overall use. Consult local production and pest management personnel for current herbicide recommendations and combinations to most effectively manage specific weed problems.

Cultivation

Cultivation practices effectively control young weeds until the bean crop becomes too large. Various types of tillage equipment are used, including the rotary hoe, spike or spring-tooth and flex-tine harrows. Selection of cultivation equipment depends on the stage of plant development, row width, soil type and personal preference. Cultivation equipment and operations must be controlled carefully to minimize damage to foliage and the shallow root system of bean plants. Ridging of some soil around the base of plants is necessary to promote secondary root development and to facilitate bean cutting and pulling. Machinery should never be operated while soil is wet to avoid soil compaction, or when plant foliage is wet to avoid mechanically spreading pathogens such as those responsible for bacterial diseases.

Irrigation

Nearly 70 percent of Colorado's dry bean acreage is irrigated by furrow or sprinkler systems. The amount of water required to produce a crop varies according to plant density, yield potential, climate and evapotranspiration demand. Timeliness of irrigation is vital for optimum yields. Avoid moisture stress or overwatering that can aggravate soil-borne disease problems and reduce soil aeration, leach nutrients and concentrate salts at the soil surface. Irrigation water quality also is important, and water containing high amounts of salt (greater than 2 mmhos/cm) should not be used for beans.

Furrow irrigation usually requires three to five applications to provide moisture in the upper 2- to 4-foot layer necessary for proper root development and plant maintenance. Alternate row irrigation is a common practice since it provides better soil aeration and usually reduces irrigation time. If possible, the first irrigation should fill the soil profile or potential root reservoir before planting. A post-seeding irrigation to provide moisture for plant emergence should be avoided since it may promote conditions favorable for pathogens causing root rots. Timing of the second irrigation depends upon the climate after planting, but generally is required prior to flowering. Prompt irrigation at this point is vital for optimum yield and maturity. Early bloom is the period of maximum water use and greatest yield response to water. If needed, subsequent irrigations usually are made on a 7 to 10 day schedule. Late season irrigation may aggravate white mold problems and stain light-colored market types.

Producers with sprinkler irrigation systems should follow similar guidelines to satisfy crop requirements for water. Preplant irrigation is recommended when possible. Subsequent irrigation applications usually are smaller than with furrow irrigation, however, more applications are needed to produce the crop. Sprinkler irrigation should be timed so foliage can dry before darkness to reduce environmental conditions favorable to foliar diseases. Avoid frequent light irrigations that keep the soil surface wet and promote white mold development.

Harvesting

Bean plants can be cut and pulled when 33 percent to 50 percent of the pods turn yellow. Green pods that have a red marking or are in the full bump stage should produce mature seed. If harvest is delayed until the dry pod stage, it is necessary to cut and windrow during early morning hours when dew on the plants minimizes pod shattering. During warm, dry weather, beans may be dry enough for combining five to seven days after cutting. In wet weather, it may be necessary to rake or lift the plants to promote drying and minimize staining of light-colored seeds. High winds are a hazard to windrowed beans by scattering beans and shattering seeds from dried pods.

Combines with pickup attachments generally are used to thresh pulled and windrowed beans. The combines are rotary or grain combines with spike-tooth, tine-tooth or rasp-bar cylinders. Cylinder speeds must be adjusted carefully to 150 to 350 rpm, depending on seed moisture. Higher cylinder speeds will cause cracking and splitting. Other adjustments such as the concave clearance, adjustable chaffer, cleaning sieves and fan speed must be adjusted carefully and monitored during threshing.

Bean seed always should be handled carefully to minimize seed coat damage. Bean ladders or belt conveyors should be used to move beans, especially when the seed is dry. Augers cause damage, and if used should be run at full capacity and at low rpms to reduce seed damage.

Bean straw, which may be contaminated by pests, should be incorporated into the soil after harvest to minimize potential disease epidemics or insect outbreaks in the future. However, appropriate cultural practices are required to reduce wind erosion during winter months.

Pest Management Recommendations

Dry beans are affected by plant diseases and insect pests that occur throughout production regions of Colorado. These pest organisms can reduce crop yields unless preventive and/or curative management practices are implemented at the correct time. This section describes common disease and insect pests found in Colorado and recommendations for their management. Additional information is available in other publications and from local Cooperative Extension, Colorado Agricultural Experiment Station research centers and bean industry personnel.

Plant Diseases

Root rots are caused by *pythium* damping off, *rhizoctonia* root rot, *fusarium* root rot and *fusarium* wilt. These diseases can affect seed, seedlings and plants by infecting the roots, hypocotyls and lower stems. Infected plant parts may become tan, brown or red and rotted, thereby causing the plants to be stunted, yellowed or even killed. Disease management strategies include: crop rotation, varietal selection, proper planting date, seed/soil treatment with fungicides, tillage practices to minimize soil compaction and root pruning, and irrigation management to minimize moisture extremes.

Viral diseases such as *bean common mosaic, bean yellow mosaic* and *curly top* can affect the leaves, stems, branches and pods. Symptoms include discoloration, distortion, stunting and death of plant parts. Some viral diseases can be seed-borne. Viral diseases also can be spread by insect vectors such as aphids and leafhoppers, or by mechanical injury. Disease management strategies include: crop rotation, selecting resistant varieties, tillage practices to minimize mechanical injury, and weed control.

Bacterial diseases such as *halo blight, bacterial brown spot* and *common bacterial blight* cause lesions that are yellow to brown on the leaves, stems, pods and seeds. These plant parts may become shriveled and water-soaked. The bacterial pathogens survive on and in the seed and plant debris. Disease management strategies include: crop rotation, residue and volunteer bean incorporation, selecting resistant varieties, certified and treated seed, proper planting date, tillage practices to minimize mechanical damage, restricted movement in fields while foliage is wet, irrigation management to avoid reuse of irrigation runoff from other bean fields, and timely sprays of copper fungicides.

Rust primarily affects plants during pod formation by causing reddish brown spots or pustules on foliage. The pustules can cover large portions of leaves and cause them to shrivel and fall prematurely. Early and severe infections also reduce seed size. Disease management strategies include: crop rotation, residue and volunteer bean incorporation, selecting resistant varieties, proper planting date, irrigation management to keep foliage dry and canopy humidity low, and timely sprays of foliar fungicides.

White mold can affect leaves, branches, stems, pods and seed after pod formation. It produces a watery rot that becomes covered by a white, fluffy, moldy growth. Disease management strategies include: rotation with non-host crops, varietal selection, adequate but not excess fertility and plant populations, irrigation management to keep the soil surface as dry as possible after pod formation, and timely sprays with foliar fungicides.

Insect Pests

Soil insects, such as *wireworms* and *seedcorn maggots,* feed upon the underground portion of seedlings and reduce stands early in the cropping season. Insect management strategies include: fall plowing of previous crop residue, proper planting date, and seed treatment with insecticides.

Western flower thrips can feed on leaf surfaces, but usually are found within flowers. High populations of *aphids* and *leafhoppers* can reduce plant vigor and yield by sucking water and nutrients. Some species transmit bean virus organisms. *Spider mites* can infest beans in western production regions. However, these types of insects seldom pose serious threats to the crop. As a general management practice, follow recommended irrigation and fertilization guidelines to minimize plant stress during the growing season.

Coppery-brown *Mexican bean beetles* and their yellow larvae feed on the undersides of leaves to cause a lace-like or skeletonized appearance. Tiny black or yellow-black *flea beetles* also feed by cutting shot holes in bean leaves. Plants usually outgrow flea beetle damage, which is most prevalent during the seedling stage. Insect management strategies include: preplant systemic and foliarly applied insecticides if more than one Mexican bean beetle is found per one foot of row or more than one yellow egg mass is found per 6 feet of row, during scouting. At times, beetles also are naturally controlled by a small parasitic wasp, *Pediobius foveolatus.*

Western bean cutworms are a pest of corn and beans. The insect damages beans by chewing holes in pods and young seeds. Insect management strategies rely upon foliar applications of insecticides before the insects enter pods. Scouting for the white egg masses and larvae (on the upper leaves of 5 percent to 10 percent of the corn plants) is commonly done in adjacent corn fields when beans reach late flowering and early pod formation.