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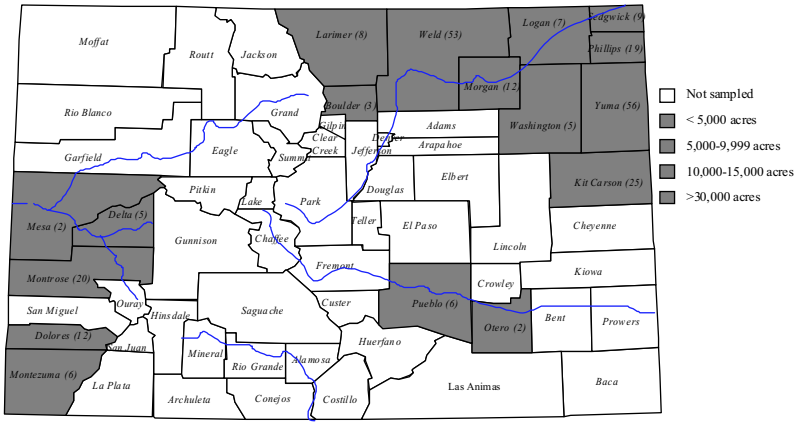
Colorado Dry Bean Fields Sampled For Alkali Soils

Soil testing helps producers determine if their soil has high salt, high pH or high sodium -- three different soil conditions.

BEAN ISSUE INSIDE:

Figure 1. Bean acreage and sample number (in parentheses) by county



The term "alkali" is frequently used to describe soils that are high in salt. But sometimes people use the term to mean high pH, and other times to mean high sodium. Since people use the word "alkali" to describe a number of different soil problems, we decided to survey Colorado bean fields to determine whether these three different situations occur in Colorado. During the summer of 1998, we sampled 250 dry bean fields throughout Colorado bean growing areas (see Figure 1 for sampling locations). We focused on dry beans, since they are more sensitive to these problems than most other crops.

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Alkali

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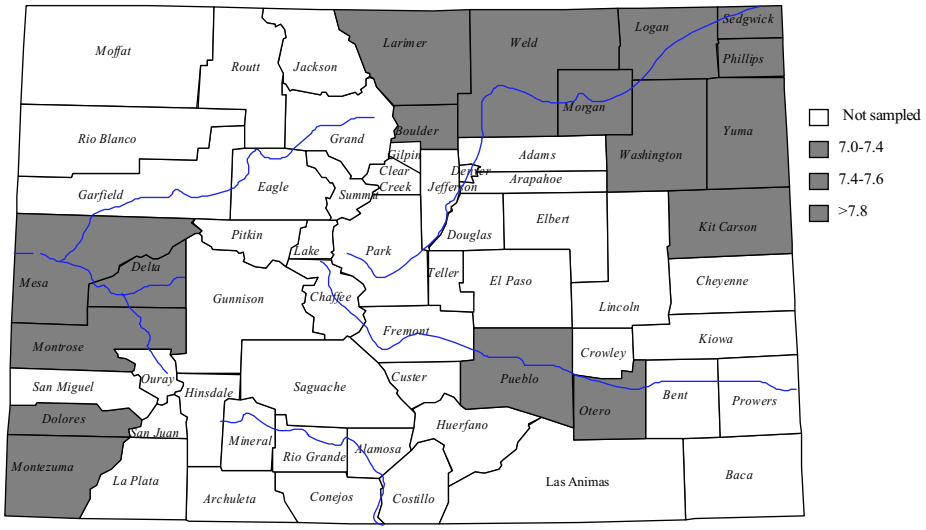
High pH soil doesn't typically look any different from soil with neutral pH. However, the plants growing in that soil often provide clues about the problem because high pH reduces the availability of nutrients such as zinc, iron, or phosphorus. Therefore, symptoms of yellowing of middle to upper leaves (signs of zinc and iron deficiency) or dark green coloring with purpling of the lower leaves and stems (signs of phosphorus deficiency) can be symptoms of high soil pH. These deficiencies become important and can lead to reduced bean yields when pH is above 7.8. Visual symptoms can be used to diagnose these problems, but ultimately soil testing is the best way for an accurate diagnosis.

Figure 2. Average pH by county



Soil testing showed that 34% (85 out of 250 fields) of Colorado bean fields that we sampled had soil pH levels of 7.8 or higher and pH ranged from 5.6 to 8.2 across the state. The counties with average soil pH above 7.8 were Mesa, Delta, and Montrose in the Tri-River Area, and Larimer and Otero counties on the east side of the Continental Divide (Figure 2).

So what can be done about high soil pH? Sulfur can be used to reduce pH; however, the large amount of sulfur required to reduce pH on a field scale makes this practice uneconomical. The best approach is soil testing for phosphorus, zinc, and iron to determine whether additional fertilizer is required to meet these needs. Use fertilizers known to reduce soil pH, like urea or ammonium-based fertilizers.

Soil salinity is caused by accumulation of salts. Sometimes a white crust is visible on a saline soil surface. Plants growing in saline soils may appear to be suffering from water deficit. Dry bean yield is reduced when the salt content (electrical conductivity or EC) in the soil exceeds 1 mmho/cm. In bean fields sampled, salt content ranged from 0.2 to 5.6 mmhos/cm and 37 percent (93 out of 250 fields) had salt contents above 1 mmho/cm. The following counties had average salt contents above one mmho/cm: Larimer, Weld, Morgan, Logan, Washington, and Sedgwick in the South Platte Basin and Mesa, Delta, and Montrose in the Tri-River Area (Figure 3). About 20% of fields had both high pH and high salts (49 out of 250 fields).

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Alkali

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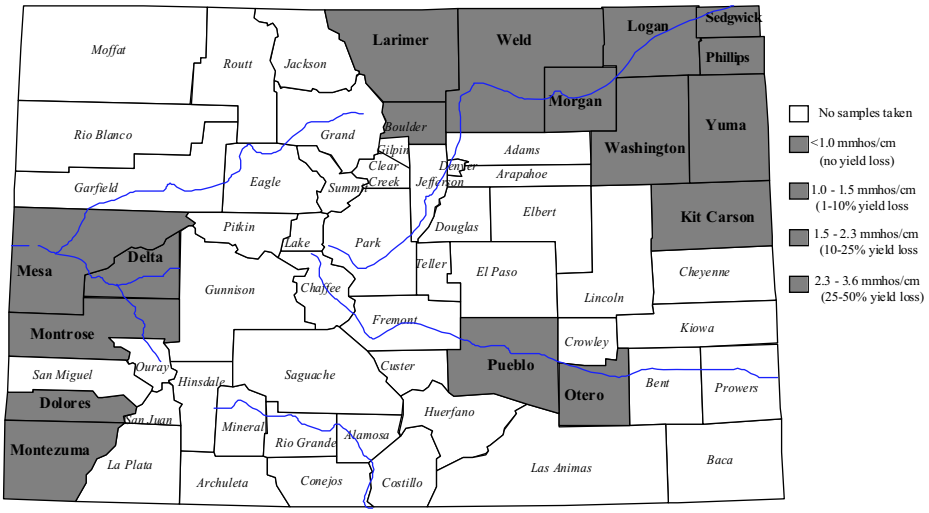
Figure 3. Average electrical conductivity (EC) by county



Treatment for high soil salts is to leach the salts out. For this treatment to work, there must be adequate drainage and acceptable irrigation water quality. Drainage can be improved with organic soil amendments (crop residue or manure) or physical improvements like drain tiles. After insuring that drainage is adequate, leach the salts out by irrigating heavily. Proper irrigation management is critical to preventing and managing soil salinity.

New products are on the market which claim to enhance water infiltration into saline soils. Most of these products were developed for sodic soils (soils high in sodium, one particular salt) not for saline soils.

Out of the 250 fields we sampled, none was sodic. The highest sodium adsorption ratio (SAR) was four, and the counties with highest average sodium levels were Morgan, Logan, Washington, and Sedgwick in the South Platte Basin (Figure 4). Adding calcium sources, such as gypsum or calcium chloride can be beneficial for sodic soils, but adding calcium to saline soils increases the salt content further and aggravates the salinity problem.

If you have an "alkali" problem, before you can fix the problem, you need to determine whether the problem is high pH, high salts, or high sodium. And the best way to diagnose the problem is through soil testing.

This study was possible through the cooperation of the farmers and county extension agents and bean processors who helped Dave Kaasa and Kirk Iversen pull soil samples, and the Dry Bean Administrative Committee who funded the sample analysis.

Jessica Davis
Associate Professor and Soil Specialist
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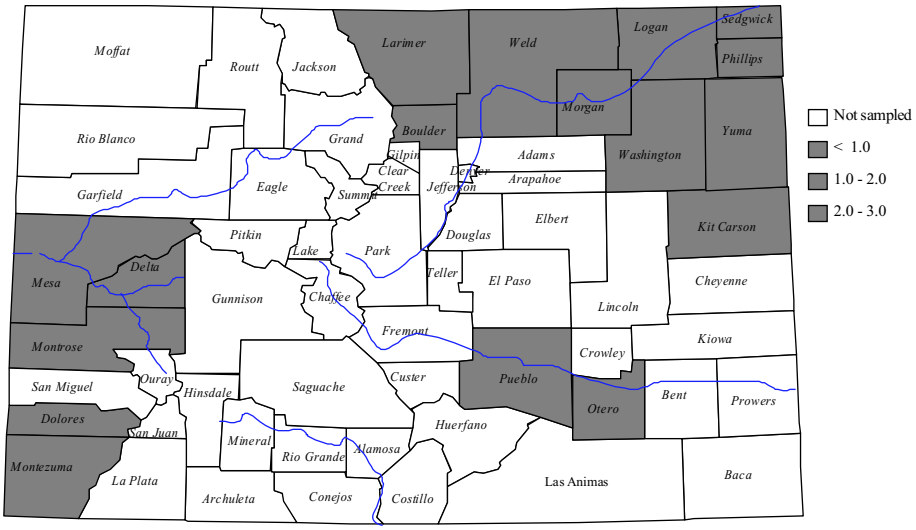
Figure 4. Average sodium adsorption ration (SAR) by county



Outlook For The 1999 Dry Bean Crop

Producers should maintain seed quality and reduce production costs to remain competitive.

Dry bean growers should ask themselves each year whether to continue growing pinto beans in light of the fact that current grower price for great northern, black, and light red kidney beans are from $4 to $14 higher than pinto. The trend in pinto bean prices has been steadily downward for the past several years despite reasonable domestic and export demand. The downward trend is due in part to increased production in the Norharvest Region of North Dakota and Minnesota, and in Manitoba, Canada.

Consider that in 1998, North Dakota alone produced almost 10 million cwt, or approximately one-third of the US dry bean crop, most of which were pinto. Production in the Norharvest/Manitoba region in 1990 accounted for only 18 to 20% of the North American crop, while in 1998 it accounted for over 40%, a doubling of concentration in eight years (Bartsch, 1999.) Why the big change? According to John Bartsch, a dry bean trader for Agricore (formerly Continental Grain Co.), dry bean production in North America will continue to shift from high cost to lower cost production regions. This shift will increase total production and decrease prices based on supply and demand forces in the market. The end result will be a shift in production from the irrigated regions in the west to rainfed production in the Midwest and Canada. The trend of lower prices is also being stimulated by cheap beans offered for export by countries such as China and Ethiopia which have recently increased production and export volume.

How can producers in Colorado and the High Plains maintain a competitive advantage in this changing market? Two areas of our production system will help us stay competitive and profitable. First, produce a quality crop that is in demand from a market willing to pay for premium quality. Premium beans that have excellent size, color and freedom from damage are still in demand by discriminating buyers such as canners and dry package processors.

Beans produced in China, Ethiopia and production zones with less favorable climatic conditions during harvest are always at risk of weather related seed damage. In these regions, production of a quality crop has been termed a "train wreck waiting to happen." When the train wreck happens and quality is degraded, we need to be ready to capitalize on the market by having a quality bean crop ready. We must continue to grow varieties that have a history of excellent quality and handle the seed during and after harvest with care to maintain the integrity of seed quality. Future marketing efforts for our beans will need to focus

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Outlook 1999

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more on quality and value than we have in the past.

Secondly, we must lower our production costs and determine the value of the bean crop in our rotations. During times of low wheat and corn prices, it is not difficult to justify beans in a rotation, because they contribute economically and agronomically to the rotation. However, when corn or wheat prices are high, it is more difficult to justify beans based on short term investment return. There are ways to lower production costs, but we must be careful what production costs we choose to cut.

Several ways to reduce costs and / or increase profits are: 1. Soil test and fertilize based on only the amount needed to produce an economic yield goal; 2. Reduce the number of tillage operations to a minimum; 3. Plant early with early to medium maturing varieties so you can market the crop early in more favorable markets; 4. Increase yield by planting the crop using double row arrangement or narrow rows to achieve more uniformity in plant spacing; 5. Avoid over-irrigation to reduce costs and disease incidence (especially white mold); 6. Produce excellent seed quality by managing the crop properly from planting to harvest; 7. Apply Rhizobium inoculant, especially in light soils, to benefit from nitrogen fixation potential, and 8. Monitor your crop two to three times a week to detect and react quickly to problems that arise.

Be careful that you do not cut costs in areas that likely will result in reduced net return. Avoid cutting costs by: 1. Buying inexpensive seed that has not been certified or produced under a stringent system of quality control; 2. Ignoring soil compaction problems; 3. Reducing seeding rate; 4. Limiting irrigation during the critical flower and early pod set stage, and 5. Not taking the time to properly adjust planting and harvest equipment that results in poor crop stand and/or seed damage.

In the final analysis, it is impossible to control the world market. However, we can control some of our production costs and improve the quality of our bean crop. You can also reduce risk based on the price fluctuations of pinto beans by diversifying a portion of your crop into market classes other than pinto.

Develop a plan and discuss it with your local dry bean buyer for advice on seed supplies and management differences between pinto bean and other market classes. In some cases, such as great northern bean, the crop can be managed almost identical to pinto bean. However, with black and light red kidney, varietal selection, seed sources and management, and especially harvest management, differ greatly from pinto bean production. Rely on bean dealers and the agronomist in your area to provide you with first hand experience regarding the best varieties and production practice for each market class.

Reference: Bartsch, John. 1999 An Inside Look at Domestic Production and Export Challenges for the '98 Crop. P. 24-30, Norharvest Bean Grower. March, 1999.

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Want To Jump Start Dry Bean Production?

Attention to these details will help Colorado dry bean producers maintain high yields.

Planting decisions are the first management decisions for your bean crop. Poor planting decisions can be costly throughout the entire growing and marketing seasons by reducing plant development and/or yield, increasing production costs, and delaying harvest to access more favorable market prices. This article will highlight some of the major points used by successful bean producers in Colorado who consistently outyield the state average by 25 % or more.

Variety selection
To choose the best variety for your farming operation it is important to maintain an up-to-date file of production records and research data on performance of varieties over years and locations, including specific fields and regional data generated by private and university personnel. Consult your production records, and obtain reports and recommendations from crop consultants and representatives of seed companies, bean elevators and universities. Attend field days and educational meetings, and subscribe to industry newsletters and other sources of information on dry bean production, pest management and marketing. Most public research data and information can be accessed through the Internet. (See Web Sites on page 9 for a variety of sites.)

Learn about the strengths and weaknesses of each variety that are of interest to you. Stay with well-adapted, proven varieties with attributes desired by the bean industry and avoid varieties with problems that require more inputs to produce and protect from pests and diseases, or have reduced acceptance by local bean dealers due to poor seed quality.

Select and confirm seed availability early for the most popular varieties. Diversify your production into different market classes and varieties to enhance yield potential and market stability over time and environments.

Select the appropriate growth habit (Type I = bush, Type II = upright, and Type III = semi-vine) for each variety that is most suitable for your cropping system and resources.

Always buy Certified seed supplied by dealers from known seed production regions of Colorado and other western states. For more information on quality seed please refer to the article by Gil Waibel. Unless you are an organic producer, seed should be triple treated to kill seed borne bacterial pathogens, insects that damage seedlings during emergence, and soil borne fungi that can reduce seedling emergence and vigor.

Cropping Systems
Dry beans should follow a 3-year or longer rotation with crops such as small grains, corn, alfalfa, or vegetables to reduce carryover of bean pathogens and specific weed species.

Field selection should consider soil drainage, field slope, herbicide carryover, soil compaction, crop residue, soil fertility and/or Rhizobium inoculants, volunteer crops, wind and water erosion, and previous disease history. Avoid fields with a history of white mold problems, and avoid rotation with crops that are white mold susceptible including soybean, sunflower or potato.

Determine the optimum row width, plant spacing, variety/growth habit and irrigation schedule for your production system. Base seeding rates on the number of viable seeds (PLS or Pure Live Seed = germination times purity % divided by 100) needed to obtain a target population. For example, Type III pinto varieties are usually planted at 60 to 70 lbs PLS to produce 72,000 to 84,000 plants per acre. Type I (e.g., light red kidney) and II (e.g., black) varieties are often planted to achieve a plant population of 85,000 to 100,000 plants per acre. Dryland beans are normally planted at 18,000 to 30,000 plants per acre.

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Production

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Planting arrangement is normally single rows spaced 22 to 30 inches, however, research data clearly indicate narrow row spacing and/or double row arrangement on beds will increase seed yield.

Tillage

Tillage operations must consider management of surface residues from the previous crop, weed control, incorporation of fertilizer, and alleviation of soil compaction. If soil compaction is a concern, deep rip the soil in the fall or shallow rip at planting-time near the seed row to a depth of 8 to 12 inches to improve root development and penetration. Inter-row ripping within 2 to 4 weeks post-emergence can also be beneficial but be careful to avoid root pruning.

Planter operation

Planters need to be calibrated and seed delivery performance should be evaluated in the shop and in the field prior to planting to ensure that the desired seed spacing will be obtained. Continue to monitor seed delivery, spacing and depth in the field each time you fill the planter box.

Set the seed depth to 2 to 3 inches in moist soil, and follow with a packer wheel to insure good soil-seed contact. Under dry conditions or non-irrigated production, planting depth can be increased. Planting depth is similar for all market classes.

Planting

Bean seed should be planted in a firm seedbed after early morning soil temperatures reach 58 - 60 F at the planting depth. This temperature is generally reached between May 20 and June 5 in most parts of the central High Plains region.

Attention to the above details will help insure that dry bean seed is placed in optimum conditions to promote rapid germination and seedling emergence. However, even the best plans can be altered by conditions beyond the control of the producer. The following points summarize some of the early-season problems that may occur pre- or post-emergence. Consult your crop consultant and other industry or university experts for advice on additional management options.

Post-planting

Baldheads are seedlings with broken or dead growing points due to mechanical seed damage caused by poor seed handling or improperly adjusted planting equipment.

Snakeheads are seedlings damaged by seed corn maggot feeding that leaves a ragged edge around primary leaves and growing points of affected plants.

High temperatures during emergence can induce scald of seedlings.

If cold weather persists for a few days after planting, seedling emergence may be delayed which extends the period of seedling exposure to herbicides and soil-borne pests like Pythium, Rhizoctonia, Fusarium, and insects such as maggots or wireworms. These pests can kill seedlings before or after emergence, thereby reducing stand density and seedling vigor. Seed treatment with pesticides is employed as a routine preventive practice.

Surface soil crusting can develop, especially on heavy soils when rainfall occurs after planting. The crusted layer restricts seedling emergence and reduces stand density. Crusting can be alleviated by rotary hoeing the soil surface or a light application of irrigation water.

Replanting of beans may be considered if stand density is too low (less than 60 to 70% of the desired stand). The bean crop can be replanted with an early variety if there is sufficient time for the replant crop to mature, or planted to alternative crops that are compatible with any pre-emergence herbicides applied to the field.

Much of this information was extracted from the Dry Bean Production and Pest Management Regional Bulletin No. 562A; contact the Colorado State University Cooperative Extension Resource Center at 970-491-6198 for information on availability and cost of this resource and others developed by university experts in Colorado and surrounding region.

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Seed Quality Is An Important Component Of Bean Production

Seed growers follow specific procedures to ensure high quality bean seed.

Seed quality is one of the most important components that helps to ensure a profitable bean crop. The fundamental components of quality bean seed lots are genetic purity, high germination levels, absence of noxious weed, common weed and other crop seed, and assurances that the seed is free from seed borne pathogens.

Seed quality starts with genetic purity. Genetic purity programs assure the buyer that the seed is composed of the variety stated on the label. Certification programs, and private seed companies have quality control programs that maintain detailed pedigree records and field inspections to ensure varietal purity and identity throughout seed production, processing and sales. Seed producers must keep records of the seed source used as planting stock, and rogue off-types if they occur in the field.

Among the most important components of high quality bean seed is assurance that measures have been taken to prevent seed borne pathogens. Most bean seed is produced in the semi-arid western US, where low humidity and furrow irrigation reduce the incidence and spread of seed borne bacterial and viral pathogens. Furthermore, seed fields are inspected for the presence of these pathogens to reduce the potential for seed borne contamination. Seed fields that exhibit any seed borne bacterial disease symptoms cannot be Certified. These measures provide bean producers assurance that if they purchase Certified bean seed or seed from a reputable company, the seed will not serve as a primary source of disease infection.

The germination percentage stated on the label is an important guide to the quality of seed in the bag. A high germination percentage enables producers to establish a uniform vigorous stand. If the germination percentage is low, the grower can compensate by planting a higher rate of seed. However, quality bean seed should have germination levels above 85%, and relatively low dormancy. Seed dormancy is reported as hard seed on a seed label. A high percentage of hard seeds is not desirable, because hard seeds may not readily imbibe water and germinate rapidly; consequently germination may be uneven. When the "hardness" is broken in time, the resultant plants from these hard seeds can cause uneven maturity of the crop at harvest. If the hard seeds do not germinate in the growing season, they may germinate as an undesirable crop species in the future. The seed label will report the percentage of germination, hard seed, and the sum of germination and hard seeds, which is reported as total viability.

High quality seed lots are free of weed and crop contaminants. A great deal of money and effort is spent on controlling weeds each year, and the seed source should not contribute to the problem. It is recommended that a grower purchase seed that is weed free, and make certain it is free of noxious weed seeds. Contamination with other kinds of beans or other inseparable crop seeds should also be avoided in seed.

Purchasing quality seed from a reputable dealer, is a wise investment. Reputable seed dealers conform to state and federal seed laws pertaining to seed quality and the Plant Variety Protection Act. Commercial bean production can present many obstacles throughout the season. One factor a grower can control is the quality of seed he plants.

Gil Waibel, Manager
Colorado Seed Growers Association

web sites

http://www.colostate.edu/Depts/SoilCrop/extension/CropVar/index.html
Variety performance test results for Colorado crops, including beans.

http://www.colostate.edu/Orgs/VegNet/vegnet/beans.html
Information on dry bean production including growth stages, pest management decision strategies, and annual reports. Updated weekly during growing season.

http://beangenes.cws.ndsu.nodak.edu
Bean Genes web site contains information on genome project, bean pedigrees and bean variety performance trial results.

http:/beangenes.cws.ndsu.nodak.edu/vartrials/usa-trials.html
US Common bean variety performance trial results.

http://www.nebraskadrybean.com/html/international_promotion.html
National Dry Bean Council page with information on national and international production and marketing.

http://www.nebraskadrybean.com/index.html
Nebraska Dry Bean Commission home page with information on the commission, Nebraska and US Bean production, nutrition, research, and promotion.

http://www.nebraskadrybean.com/html/domestic_promotion.html
American Dry Bean Board page with national marketing information.

Dry Bean Management Clinic Field School
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7 a.m. to 5:30 p.m.
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Bean Production	Stages of Development	Herbicide Mode of Action and Injury	

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