NebGuide
Published by University of Nebraska–Lincoln Extension, Institute of Agriculture and Natural Resources

G1713

Fertilizer Management for Dry Edible Beans

Gary W. Hergert, Nutrient Management and Soil Quality Specialist
Jim Schild, Extension Educator

Soil sampling and proper N fertilization of dry beans will help producers obtain consistent top yields.

Excellent yields of high quality dry beans can be obtained in western Nebraska. Traditional growing areas include the Panhandle and southwest Nebraska, western Wyoming and eastern Colorado. High bean yields are produced on disease-free fertile soils. Dry beans respond to fertilizer if soil tests show nutrient levels in the low to medium fertility range.

Soil samples representative of the field should be taken preplant from the tillage layer (usually 0-8") for pH, phosphorus, potassium, zinc, iron and salinity and to a depth of 30 inches for nitrate-nitrogen. Information from these tests allows the producer to make informed decisions on fertilizer needs and to determine the potential for any soil pH or salinity problems.

Nitrogen Recommendations

Dry beans are a member of the legume family and are able to symbiotically fix nitrogen from the air. The nodules on the roots contain bacteria that fix nitrogen for plant use *(Figure 1)*. Inoculum containing the Rhizobium bacteria can be purchased and applied with the seed or to the soil in the seed furrow. If there is no history of dry bean production on the field, inoculation of the beans at planting time is essential. If dry beans recently were grown on the land and the beans were well-nodulated, inoculation is unnecessary.

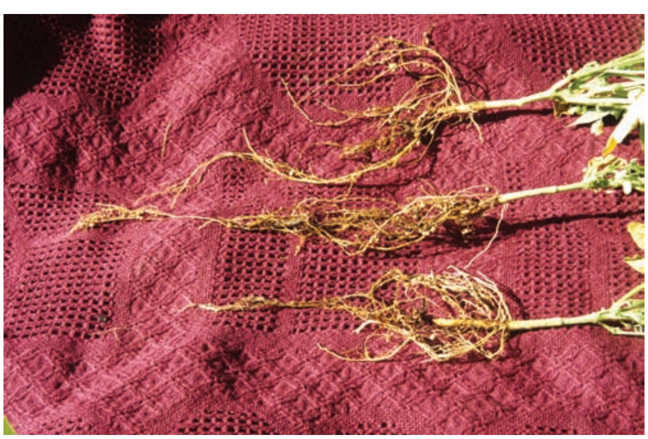

Figure 1. Nodules on dry bean roots.

Research in the Nebraska Panhandle has shown the addition of nitrogen fertilizer can increase seed yield if soil nitrate-N levels are low. Dry beans need 100 to 125 pounds of N per acre for top yields, in addition to N fixed by the plant. This additional N can be residual soil nitrogen, fertilizer nitrogen, nitrogen in irrigation water, nitrogen in manure or a combination of these sources.

N rates based on residual nitrate-N are shown in *Table I*.

Table I. Nitrogen fertilizer suggestions for irrigate dry bean (2500-3000 lb/ac) yield.

Lbs NO_3-N in 30 inches	*ppm NO_3-N in 30 inches*	*Fertilizer N - lbs/acre*
0-20	0-2.2	100
21-40	2.3-4.4	80
41-60	4.5-6.7	60
61-80	6.8-8.9	40
81-100	9.0-11.1	20
>100	>11.1	0

Nitrogen rates can be reduced if the irrigation water has a high nitrate level. The pounds of nitrogen applied per acre foot of irrigation water is calculated by multiplying the parts per million nitrate-N in the irrigation water times the factor 2.72.

Surface irrigation water nitrate levels fluctuate over time but normally will be relatively low. During the irrigation season, nitrate levels in the North Platte River in western Nebraska ranged from 1.5 to 5.0 ppm nitrate-N. The median level was 3 ppm or 8 lbs N/acre foot. Well waters show considerable difference in nitrate-N, so well water testing is recommended.

The use of nitrogen fertilizer for dry beans does have some limitations. Excessive N rates can delay maturity. The same effect is seen when planting dry beans in a newly plowed

Figure 2. Dry beans on the right received 80 lbs N per acre. Beans on the left received no N. Additional N promotes foliage growth which can enhance vulnerability to white mold.

alfalfa field. Planting dates and/or varieties should be adjusted to compensate for the delayed maturity. Nitrogen fertilizer also will increase the amount of foliage produced *(Figure 2)*. This can be a serious problem in fields with histories of white mold. The incidence of white mold damage, when present, can be increased as much as 30 percent with nitrogen fertilization.

Phosphorus Recommendations

Dry beans respond to phosphorus fertilizer when soil test levels are low. Banding phosphorus is more efficient than broadcasting, consequently the application rate for banded P is one half the broadcast rate. Banding improves P availability in cool, wet or compacted soils. P fertilizers have relatively low salt indices, but contact between the fertilizer band and the seed should be avoided. Obtaining a soil test and following the phosphorus rates recommended in *Table II* will produce the best results

Table II. Phosphorus recommendations for dry beans.

Phosphorus soil test method and critical levels			*lbs P_2O_5/acre*	
Olsen-P	*Bray P-1*	*Mehlich 3*	*Banded P*	*Broadcast P*
0-3	0-5	0-6	30	60
4-6	6-10	7-12	20	40
7-9	11-15	13-18	10	20
$\geq$10	$\geq$16	$\geq$19	0	0

Potassium Recommendations

In western Nebraska, where dry beans traditionally are grown, soils are very high in potassium. Dry beans have not shown a response to potassium fertilization on soils testing over 125 ppm K. Potassium recommendations are shown in *Table III.*

Table III. Potassium recommendations for dry beans.

Potassium Soil Test ppm K	*Potassium to Apply lbs of K_2O/A*
0 to 40	60
41 to 74	40
75 to 124	20
>125	0

Zinc Recommendations

Zinc is the most common micronutrient deficiency of dry beans in Nebraska. Zinc deficiency can occur when the topsoil has been removed by leveling or erosion. Soils low in organic matter, compacted soils, sandy soils and/or soils with a pH greater than 7.3 may exhibit zinc deficiency. It also can be a problem when beans follow sugar beets.

As with P, banding is more efficient than broadcasting and half as much Zn is recommended for banding. Zinc does not revert to insoluble forms as rapidly as other micronutrients, so broadcast application provides residual effects for several years. Soluble sources of zinc (zinc sulfates, zinc chelates or zinc-ammonia complexes) are preferable to zinc oxide-based materials.

Zinc recommendations are shown in *Table IV.*

Table IV. Zinc recommendations.

DTPA Soil Test Zn -ppm	*pH less than 7.5*		*pH more than 7.5*	
	# Banded Zn	*# Broadcast*	*# Banded Zn*	*# Broadcast*
0-0.5	3	6	5	10
0.51-1.0	2	4	4	8
1.01-1.5	1	2	2	4
>1.5	0	0	0	0

Iron Recommendations

Iron deficient dry beans can occur on soils with pH values greater than 7.5 that contain free calcium carbonate and have low organic matter *(Figure 3)*. Dry bean breeding programs in the region have selected varieties that tolerate high pH. Problems occur with varieties not adapted to high pH conditions. In addition, cool wet springs increase the

Figure 3. Iron chlorotic (yellow) dry bean next to a normal plant.

probability of iron chlorosis. As these soils warm up or lose moisture, iron chlorosis often disappears without any iron treatment. If chlorosis persists, yield losses can occur. Soil application of iron is generally not effective. Deficiencies can be corrected by spraying the crop with a 1 to 1.5 percent ferrous (iron) sulfate solution at the rate of 20 to 25 gallons per acre. Aerial application does not provide sufficient coverage because of gallonage limitations.

Other Micronutrients and Sulfur

Other nutrient deficiencies (boron, chlorine, copper, manganese, molybdenum) have not been observed in the High Plains dry bean growing region. Documented responses to sulfur applications are rare. The most likely need for sulfur would occur on sandy soils with low organic matter, and soils irrigated with water low in sulfate-sulfur (< 6 ppm SO_4-S). If sulfur is required, 10 lbs S from a sulfate source is recommended.

Salinity

Dry beans are one of the most sensitive crops grown in Nebraska to soluble salts. A saline/alkali soil test should be run on soils suspected of having a salt problem. Salinity levels testing over 2 dS/m (mmhos/cm) normally cause some injury and reduce yields. Salt sensitivity of several crops is shown in *Table V*.

Table V. Salt sensitivity to crops.

	Relative yield decrease in yield - percent			
Crop	*0*	*10*	*25*	*50*
	dS/m salinity level causing yield reductions above			
Dry Bean	1.0	1.5	2.3	3.6
Corn	1.7	2.5	3.8	5.9
Wheat	5.0	7.4	9.5	13.0
Sugar Beet	7.7	8.7	11.0	15.0
Barley	8.0	10.0	13.0	18.0

The most common effect of salts is on the plant's ability to absorb water. The symptoms of salt injury on the bean plant are stunting, smaller, thicker, darker green leaves, or in some cases, burning around the leaf margins *(Figure 4)*. The effects of salts can't be separated from water stress since salts contribute to moisture stress in the plant. The bean plant is most sensitive to salt effects during germination and early growth.

Most soils normally don't have salt concentrations high enough to cause injury to beans, but under drought and high temperatures salts may accumulate near the soil surface and injure the developing seedling. The same conditions of high temperatures and low soil moisture also can affect preplant herbicide performance, which may lead to herbicide injury. The possibility exists for all these factors to interact and dramatically reduce bean yield. The best strategy to counteract the salt stress problem is to irrigation the crop early and leach salts out of the soil zone where the crop is germinating and beginning development *(Figure 5)*.

Figure 4. Salt damage to dry bean (Photo courtesy of R.G. Wilson).

Figure 5. Dry beans showing no salt damage (foreground) and dry beans in an area with salinity above 2 dS/m (Photo courtesy of R.G. Wilson).

UNL Extension publications are available online at *http://extension.unl.edu/publications*.

Index: Field Crops
Miscellaneous Crops
Issued May 2007