1985

Fertilizing Soybeans

Cooperative Extension South Dakota State University

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FS 748

FERTILIZING SOYBEANS

Cooperative Extension Service
South Dakota State University
U.S. Department of Agriculture

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Soybeans in South Dakota respond to direct fertilization if soil test levels of phosphorus and potassium are low. Even if soybeans are not fertilized directly, they still often benefit indirectly from fertilizer use on other crops in the rotation.

Soybeans are a legume and can fix their own nitrogen. Consequently, they do not respond to nitrogen fertilizers if they are adequately nodulated.

Nitrogen and Inoculation

Each bushel of soybeans contains 3.7 lb of nitrogen (N). An additional 0.8 lb N is present in the stover for each bushel produced, giving a total nitrogen content, excluding roots, of 4.5 lb/bu. High soybean yields, therefore, will demand large quantities of nitrogen.

Fortunately, properly nodulated soybeans meet their own nitrogen needs through symbiotic fixation of atmospheric nitrogen. Adding large amounts of nitrogen reduces nodule development and seldom increases yield. If nitrogen fertilizer increases soybean yield, the crop was not adequately nodulated.

For soybean nodulation and fixation of atmospheric nitrogen to occur, certain species of Rhizobium bacteria must be present in soil at planting, added to the soil, or inoculated onto the soybean seed. Inoculation is essential in areas where soybeans have not been previously grown. Inoculation also provides good insurance if soybeans have not been grown within the last 3 years or if previously grown soybeans were not adequately nodulated.

Several types of inoculum are currently available for soybean seed treatment. The most common is a peat based material.

Peat is a good carrier for soybean inoculum but does not adhere to the seed as well as some other materials. For best results, peat based materials should be applied as a slurry and mixed with the seed. This will greatly increase the number of bacteria sticking to the seed and is particularly recommended when planting in fields without a previous soybean history.

A clay based inoculum will stick to the seed when applied dry. The clay, however, becomes sticky when wet and should not be left in the planter overnight.

A granular inoculum can be applied separate from the seed through the insecticide or herbicide hoppers. Granular materials are more expensive but are very effective because they supply large amounts of bacteria. They are recommended for new soybean land.

Many seed treatments reduce the viability of inoculum. Soybean seed treated with fungicides should not be inoculated more than 4 hours prior to planting.

The viability of soybean inoculum is dependent on storage time and conditions. Inoculum should be stored in a cool place or refrigerated, and be used prior to the expiration date on the bag. Inoculum is easily killed by high temperatures or direct sunlight.

Pre-inoculated soybean seed may be of questionable value. Such seed is inoculated when it is bagged, and if warehoused for several months at variable temperatures, it is possible that not enough bacteria will survive. Use pre-inoculated seed with caution. For insurance, you can inoculate again at planting.

To check for nodulation, dig up a few plants when they are flowering and carefully break soil away from the roots. You should see large numbers of nodules (as on the cover of this fact sheet). If only three or four nodules can be found, the soybeans are not effectively nodulated. High amounts of nitrogen fertilizer or high soil nitrate levels will reduce nodulation even if viable inoculant is present.

Phosphorus and Potassium

Soybeans respond to direct applications of phosphorus (P) and potassium (K) fertilizers when soil test levels are in the low or medium ranges. Recommended phosphorus and potassium fertilizer rates depend on soil test level and yield goal. Recommendations are given in tables 1 and 2.

Phosphorus and potassium fertilizer may be broadcast and incorporated prior to planting or applied in a starter band 2 inches beside and 2 inches below the seed. No fertilizer should be directly in contact with the seed. If the recommended amount of phosphorus or potassium is less than 20 lb/A, it should be applied as a starter. If a starter is used, up to 15 lb/A N can be included.

Table 1. Phosphorus recommendations

	Soil Test phosphorus, lb/A				
	V. Low	*Low*	*Med.*	*High*	*V. High*
Yield	*0-5*	*6-15*	*16-25*	*26-40*	*41+*
goal	*3*	*10*	*20*	*33*	*41*
bu/A	*lbs P_2O_5/A recommended*[1]				
20	27	23	16	0	0
30	37	31	22	0	0
40	46	40	28	11	0
50	56	48	34	14	0
60	66	56	40	18	0
70	76	64	46	21	0

[1]Recommendations listed are for the center of each soil test range.

Table 2. Potassium recommendations

	Soil Test potassium, lb/A			
	Low	*Med.*	*High*	*V. High*
Yield	*0-100*	*101-200*	*201-350*	*351+*
goal	*50*	*150*	*275*	*351*
bu/A	*lbs K_2O/A recommended*[1]			
20	24	22	0	0
30	38	32	0	0
40	51	42	0	0
50	64	52	18	0
60	77	62	24	0
70	90	72	30	0

[1]Recommendations listed are for the center of each soil test range.

Micronutrient Needs

Iron chlorosis is the only micronutrient deficiency of importance for soybean production in South Dakota. Iron deficiency shows as yellow leaves with green veins (interveinal chlorosis). It occurs on soils with high pH or in areas of high salt concentration and poor drainage.

Iron deficiency occurs more frequently in the spring when conditions are cool and wet. Usually, only small areas in the fields (several acres or less) are affected. When soil conditions become dry and temperatures warm, the deficiency usually disappears.

Foliar applications of chelated iron compounds may be successful in reducing iron deficiency symptoms. Apply as a band over the row when the beans are putting out the second trifoliate leaves. Precise timing is essential; later applications (third or fourth trifoliate stages) are usually ineffective.

Studies in neighboring states indicate the iron chelate EDDHA to be the most consistently effective material to use. It is found under commercial names such as Sequestrene 138 or Chel 138 H Fe. It should be band applied over the row at a rate of 0.10 to 0.15 lb/A actual iron. Material landing on soil will generally be ineffective.

Foliar applications should be made when temperatures are low and humidity is high. If soluble salt levels in soils are high, there may be no response to iron.

Due to the somewhat inconsistent response to iron, the precise timing required, the high cost of treatment, the relatively small areas affected, and the tendency for most plants to recover, it is often not economical to treat iron deficient soybeans.

It is usually more practical to select soybean varieties which are resistant to iron chlorosis if significant acreages are affected. Public soybean varieties have been rated for their resistance to iron chlorosis (Table 3). Private companies can usually supply information on iron chlorosis resistance of their varieties.

Liming

Liming trials throughout the upper Midwest indicate that a soil pH as low as 6.0 can produce maximum yields. Liming studies in South Dakota demonstrate no response to lime at a soil pH of less than 6.0 when soil layers with a neutral pH exist in the upper 24 inches of the soil profile.

Since most South Dakota soils contain a neutral or higher pH zone in the upper portion of the soil profile, a response to lime is not likely. Lime should be used only on a trial basis when the surface soil pH is 5.9 or lower.

Summary

Fertilization is only part of a total program. The response of soybeans to fertilizer is more likely when other management factors are optimum, such as varieties, row spacing, and weed control.

An effective fertilization program should include **soil testing**, followed by applications of phosphorus and potassium fertilizers when test levels are in the low or medium range, and **inoculation** where soybeans have not been grown recently.

Table 3. Iron chlorosis resistance of selected public soybean varieties (data obtained from the Uniform Soybean Tests—Northern States).

Variety	*Maturity Group*	*Chlorosis score*[1]
McCall	00	2.8
Ozzie	0	2.6
Evans	0	2.8
Dawson	0	1.6
Swift	0	2.7
Simpson	0	2.8
Hodgson 78	I	2.4
Hardin	I	3.8
Lakota	I	1.2
Weber	I	2.2
Weber 84	I	2.2
Corsoy 79	II	4.4
Elgin	II	2.2
BSR 201	II	4.8
Wells II	II	3.8
Hack	II	4.0
Miami	II	3.6
Century 84	II	4.6
Harcor	II	5.0
Platte	II	4.0
Nebsoy	II	4.0
Benson 80	II	1.0
Century	II	2.5
Amcor	II	4.0
Gnome	II	3.6
Zane	III	4.4
Hobbit	III	3.6
Will	III	4.0
Mead	III	4.5
Pella	III	3.4

[1] 1 = high resistance (little yellowing), 5 = poor resistance (severe yellowing)

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File: 3.3—2.6M(new)—3-85mb—ES 337.

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