Soybeans, Single-cropped

Management Highlights

- Target pH: **6 0**
- Monitor crop for Mn deficiency, **especially** when soil test Mn is less than 3.4 lbs/ac.

Yield Goals

Soybean yields are influenced by many factors, including the cultivar selected, planting date, soil type and water-holding capacity, nutrient and water availability, weed, insect and disease pressure and crop management practices. Table 1 shows typical yield goals for single-cropped soybeans grown on Delaware soils. As indicated, irrigation use can increase soybean yields by several bu/ac. Likewise, since no-tillage production systems favor water conservation and an early planting date, no-till soybeans frequently produce higher yields than do conventional-tillage soybeans grown on the same soil type. Soybeans produced under conservation-tillage practices can be expected to produce yields between the management extremes of conventional-tillage and no-tillage systems.

Table 1. Single-cropped soybean yield goals as a function of soil type, tillage and irrigation use.

	Non-irrigated		Irrigated
Soil Type	**CT***	**NT****	
	--------- bu / ac -------		
Sands, loamy sands	40	45	60
Sandy loams, loams	45	50	60
Black soils	45	50	65
Silt loams	50	55	70

*CT = conventional-tillage **NT=no-tillage

When field history supports the use of a different yield goal, growers should use that information to adjust management decisions and fertility programs accordingly.

Soil pH and Liming

The target pH for soybeans grown on most Delaware soils is **6.0**. Soils that are higher in organic matter ("black" soils) have a lower target pH (5.6) because organic matter moderates some of the negative effects of excessive soil acidity (e.g., aluminum toxicity).

The lime recommendation for a specific soybean field is calculated from the soil pH and buffer pH measurements using the steps outlined in ***Calculating the Lime Requirement -- Chapter 3, Section 3.4***. Avoid overliming to prevent deficiency of micronutrients such as manganese.

In most cases, the lime requirement can be met by either calcitic or dolomitic limestone.

Dolomitic limestone is recommended if:

- soil test Mg is less than 50 FIVs, or
- soil test Mg is between 50 and 100 FIVs ***and less than soil test Ca.***

Calcitic limestone is recommended if:

- soil test Mg is greater than 100 FIVs, or
- soil test Mg is between 50 and 100 FIVs ***and greater than soil test Ca.***

Nitrogen Management

Soybeans are leguminous plants and capable of fixing sufficient nitrogen (N) to meet crop needs. Nitrogen application to soybeans is, therefore, not recommended. If soybeans have not been grown successfully on the field in previous years, treat the seed with a suitable inoculum just prior to planting.

Phosphorus Management

Yield-limiting phosphorus (P) deficiency is rarely a concern on Delaware soils. Long-term applications of fertilizers and manures have resulted in P accumulations in many soils that are capable of supplying crop needs for several years with no further additions.

To determine whether P fertilization is necessary for a specific field, conduct a routine soil test. University of Delaware P recommendations for soybeans are dependent upon yield goal and soil test P value. A summary of P recommendations for Delaware single-cropped soybeans are given in Table 2 below.

Table 2. Broadcast application rates for P for single-cropped soybeans.

	P Index Value							
Yield	0	10	20	30	40	50	60	70
bu/ac	---------- lbs P_2O_5 / ac ----------							
35	100	80	60	50	30	10	0	0
40	120	100	85	65	50	30	10	0
45	140	120	100	80	60	40	20	0
50	160	140	120	100	80	60	40	0-20
55	170	150	130	110	85	65	45	0-25
60	180	160	135	115	90	70	50	0-25
65	190	170	145	125	100	80	60	0-30
70	200	180	155	130	110	90	65	0-40

Potassium Management

The need for potassium (K) fertilization of soybeans is best determined by the use of a routine soil test. As with P, K recommendations are based on expected yield and soil test K value. A summary of University of Delaware K recommendations for single cropped soybeans is given in Table 3. Potassium can be broadcast prior to planting or applied in the fertilizer band. ***To avoid salt injury to seedlings, do not band more than 75 lbs K_2O/ ac.***

Table 3. Broadcast application rates for K for single-cropped soybeans.

	K Index Value								
Yield	0	10	20	30	40	50	60	70	90
bu/ac	---------- lbs K_2O /ac ----------								
35	90	75	60	45	30	15	0	0	0
40	110	95	80	60	45	30	15	0	0
45	140	120	100	80	60	40	20	0	0
50	160	140	120	100	80	60	40	0-20	0
55	180	160	135	115	90	70	50	0-25	0
60	200	180	155	130	110	90	65	0-30	0
65	220	195	170	145	125	100	75	0-50	0
70	240	215	190	160	135	110	85	30-60	0-30

Magnesium Management

Mg application to soybeans is recommended if the soil test Mg value is less than 38 FIVs. If liming is also recommended, use dolomitic limestone to raise soil pH and increase soil Mg. If, however, liming is not necessary but Mg fertilization is still indicated, apply Mg as Mg sulfate or Mg chloride to increase soil Mg. Application rates are summarized below in Table 4.

Table 4. Application rates for soluble Mg as a function of Mg fertility index value.

Mg Index Value								
0	5	10	15	20	25	30	35	40
---------- lbs soluble Mg / ac ----------								
80	70	60	50	40	30	20	10	0

Manganese Management

Manganese (Mn) deficiency may occur in soybeans grown on Delaware soils, most often as a result of overliming soils that are naturally low in Mn. The University of Delaware Soil Testing Program uses an availability index based on the soil test Mn value and soil pH to predict the likelihood of Mn deficiency. That availability index is calculated using the equation:

$$MnAI = 101.7 - (15.2 \times pH) + (2.11 \times ST\text{-}Mn)$$

where:

MnAI = Mn availability index
pH = water pH of the soil
ST-Mn = Mehlich 3 soil test Mn in lbs/ac.

Table 3-14 in ***Chapter 3, Section 3.5.5.2 (Manganese Management)*** gives a summary of MNAI values for various soil pH-soil test Mn combinations. Interpretations of the index for soybeans are given below in Table 5.

Table 5. Interpretation of Mn availability index for soybeans.

MnAI Value	Interpretation
Less than 17	Mn deficiency is likely at this soil pH and soil Mn concentration.
17 to 25	Mn deficiency is possible at this soil pH and Mn concentration. Monitor crop for symptoms, especially if liming has been recommended.
Greater than 25	Mn deficiency is unlikely at this soil pH.

Suspected Mn deficiency can be confirmed by tissue analysis. Confirmed deficiency situations can be corrected in season by foliar applications of Mn of 1-2 lbs/ac of actual Mn as Mn sulfate, Mn oxide or Mn chelate.

When using a foliar application to correct Mn deficiency, growers may combine the treatment with a post-emergence herbicide application to reduce the number of trips across the field. Sulfate containing forms of Mn [e.g., manganese sulfate (Techmangam) and manganese-lignin-sulfate] have been shown to be antagonistic to weed control with Roundup™. To overcome this antagonism, growers should add ammonium sulfate at a rate of 17 lbs per 100 gallons of solution. Chelated Mn (Mn-EDTA) has shown a slight degree of antagonism but little to no reduction in weed control was noted in field studies.

If deficiency is predicted by the availability index or was observed during the previous growing season, it can be prevented by an application of 8-10 lbs/ac of actual Mn in the fertilizer band. Band applications of acid-forming fertilizer, which lower soil pH in the area of plant roots, may correct Mn deficiency without the addition of Mn fertilizers.

Other Nutrients

No other nutrients are known to be limiting to single-cropped soybean production in Delaware.

Additional Information

See Soil Test Notes 1, 2, 4 and 5 (Appendix APP-7) and fact sheet SF-8 of the SoyFacts series for additional information concerning fertilization of soybeans.