

Full-Season Soybean

Crop Highlights

- Target pH: 6.0
- Monitor crop for manganese (Mn) deficiency, **especially** when soil test Mn is less than 3.4 lb/ac.

Yield Goal

Soybean yields are influenced by many factors, including the hybrids selected, planting date, winter weather, soil type and water-holding capacity, nutrient and water availability, weed, insect and disease pressure and crop management practices. **Typical yield goals for single-cropped, full-season soybeans grown on Delaware soils under dryland conditions range from 35 to 70 bushels per acre. Production on black soils (>6% organic matter) or using irrigation or conservation tillage practices can increase yields up to 80 to 90 bushels per acre in good to average years.**

Delaware growers should use field history to determine the yield goal for each field and use that information to adjust management decisions and fertility programs accordingly. Delaware nutrient management law requires the use of optimal rolling average for determining the yield goal for a specific field when field history is available. To calculate the optimal rolling average yield, see University of Delaware Extension Fact Sheet [Estimating Yield Goal for Crops](#).

Soil pH and Liming

Target pH: 6.0 for most soils

Soils that are high in organic matter (e.g., "black" soils; soil organic matter >6.0%) 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 field is calculated from the soil pH and Adam-Evans buffer pH measurements using the steps outlined in University of Delaware Extension Fact Sheet [Calculating the Lime Requirement Using the Adams-Evans Soil Buffer](#). Avoid over-liming to prevent deficiency of micronutrients such as manganese (Mn).

The recommended liming source is dependent upon Mehlich-3 (M3) soil test calcium (Ca) and magnesium (Mg) reported in University of Delaware fertility index value (FIV) and can be determined using Table 1.

Table 1. Recommended type of lime as a function of Mehlich-3 soil test calcium and magnesium concentrations.

Soil Test Levels	Recommended Lime Type
M3-Mg is less than 50 FIV	Dolomitic
M3-Mg between 50 and 100 FIV AND M3-Mg is less than M3-Ca	Dolomitic
M3-Mg greater than 100 FIV	Calcitic
M3-Mg is greater than 50 FIV AND M3-Mg is greater than M3-Ca	Calcitic

Nitrogen

Soybeans are leguminous plants and capable of fixing enough nitrogen (N) to meet crop needs. **As such, the University of Delaware does not recommend application of N under average yield conditions.**

Late-season N application may be beneficial when yields consistently exceed 70 to 80 bu/ac. Under high yield conditions, consider applying a small amount of N (e.g., 20 to 30 lb/ac) through the irrigation system at pod fill (R2 to R4). Always avoid early season N applications, as N applied at this stage may delay nodulation and result in yield loss.

If soybeans have not been successfully grown on the field in previous years, treat the seed with a suitable inoculum just prior to planting or use inoculated seed.

Phosphorus

Table 2. Broadcast phosphorus application rates for full-season soybean.

Yield (bu/ac)	M3-P (FIV)										
	0	10	20	30	40	50	60	70	80	90	100
	----- lb P ₂ O ₅ /ac -----										
35	110	90	70	50	40	35	35	25	25	15	15
40	120	100	80	60	50	40	40	30	30	20	20
45	130	110	90	70	60	45	45	35	35	25	25
50	140	120	100	80	70	50	50	40	40	30	30
55	150	130	110	90	80	55	55	45	45	35	35
60	160	140	120	100	90	60	60	50	50	40	40
65	170	150	130	110	100	65	65	55	55	45	45
70	180	160	140	120	110	70	70	60	60	50	50
75	190	170	150	130	120	75	75	65	65	55	55
80	200	180	160	140	130	80	80	70	70	60	60
85	210	190	170	150	140	85	85	75	75	65	65
90	220	200	180	160	150	90	90	80	80	70	70

1. If M3 soil test phosphorus (M3-P) is “Low” or “Medium” (e.g., 50 FIV or less), broadcast and plow down the recommended rate of phosphate prior to seeding.
2. If M3 soil test P is “Optimum” (e.g., 51 to 100 FIV), broadcast and incorporate phosphate prior to seeding or surface broadcast at or shortly after planting.
3. If M3 soil test P is “Excessive” (e.g., greater than 100 FIV), the application of P in fertilizers or manures is NOT RECOMMENDED.
4. If P fertilizers are banded, reduce the rates in Table 2 by one-half.

Potassium

Table 3. Recommended potassium application rates for full-season soybean.

Yield (bu/ac)	M3-K (FIV)										
	0	10	20	30	40	50	60	70	80	90	100
	----- lb K ₂ O/ac -----										
35	100	80	60	40	40	30	30	20	20	10	10
40	120	100	80	60	40	40	40	30	30	20	20
45	140	120	100	80	60	50	50	40	40	30	30
50	160	140	120	100	80	60	60	50	50	40	40
55	180	160	140	120	100	70	70	60	60	50	50
60	200	180	160	140	120	80	80	70	70	60	60
65	220	200	180	160	140	90	90	80	80	70	70
70	240	220	200	180	160	100	100	90	90	80	80
75	260	240	220	200	180	110	110	100	100	90	90
80	280	260	240	220	200	120	120	110	110	100	100
85	300	280	260	240	220	130	130	120	120	120	120
90	320	300	280	260	240	140	140	130	130	130	130

1. Broadcast and incorporate or band potash prior to planting.
2. For banded applications, reduce the rates in Table 3 by one-half.
3. To avoid salt injury to seedlings, do not band more than 75 lb K₂O/ac at planting. When N and K₂O are banded together, the sum of the N rate and the K₂O rate should not exceed 75 lb/ac.

Magnesium

Table 4. Recommended application rates of soluble magnesium as a function of soil test magnesium.

Soluble Mg	M3-Mg (University of Delaware FIV)								
	0	5	10	15	20	25	30	35	40
lb soluble Mg/ac	80	70	60	50	40	30	20	10	0

1. Magnesium (Mg) is recommended when M3 soil test Mg is less than 40 FIV.
2. If M3 soil test Mg is less than 40 FIV and lime is recommended, use dolomitic limestone.
3. If M3 soil test Mg is less than 40 FIV and lime is not needed, apply soluble Mg according to the rates in Table 4.

Manganese

Manganese (Mn) needs are predicted by an availability index that includes M3 soil test Mn and soil pH. Interpretation is crop specific.

$$\text{MnAI} = 101.7 - (15.2 \times \text{soil pH}) + (2.11 \times \text{M3-Mn})$$

Where:

- MnAI = Mn availability index
- Soil pH = Soil pH measured in water (1:1 V:V)
- M3-Mn = Mehlich 3 soil test Mn in lb/ac

Table 5. Interpretation of manganese availability index.

Mn Availability Index	Interpretation
Less than 25	Mn deficiency is likely at this soil pH and soil test Mn concentration
25 to 35	Mn deficiency is possible at this soil pH and soil test Mn concentration. Monitor the crop for symptoms, especially if liming has been recommended.
Greater than 35	Mn deficiency is unlikely.

1. If Mn deficiency is predicted or was observed in the previous growing season, broadcast 20 to 30 lb/ac elemental Mn.
2. Broadcast applications of acid forming fertilizers may correct Mn deficiency without the elemental application of Mn in some cases but may be less effective than applications of Mn.
3. If Mn deficiency symptoms appear during the growing season or after an application of lime, a foliar application of Mn sulfate or Mn oxide at a rate of 1.0 to 2.0 lb/ac elemental Mn or chelated Mn (Mn-EDTA) at a rate of 0.5 to 1.0 lb/ac elemental Mn can alleviate the symptoms and restore yield potential. **Apply only when adequate growth is present to aid absorption of foliar Mn.**

NOTE: When using 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) may be antagonistic to weed control with Roundup™. To overcome this antagonism, growers should add ammonium sulfate at a rate of 17 lb 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 the field studies.

Zinc

Zinc (Zn) deficiency is predicted by an availability index that includes M3 soil test Zn, soil pH, and M3 soil test P. It is most common on soils with a pH of 6.5 or higher and high soil test P concentrations but may also be induced by environmental conditions such as cold, wet soils that may limit root growth.

Table 6. Interpretation of zinc availability index.

Soil Test Criteria	Interpretation
M3-Zn is less than 1.9 lb/ac	Zn deficiency is predicted
M3-Zn is less than 3.1 lb/ac AND soil pH is higher than 7.0	Zn deficiency is predicted
M3-Zn is less than 3.1 lb/ac AND soil pH is 6.6 or higher AND M3-P is 100 FIV or higher	Zn deficiency is predicted
M3-Zn is 3.2 lb/ac or higher	Zn deficiency is unlikely

If zinc deficiency is predicted by the availability index or was observed the previous year, one of the following treatments can be applied:

1. Broadcast Zn sulfate or Zn oxide at a rate of 10 to 12 lb/ac elemental Zn or Zn chelate (Zn-EDTA) at a rate of 2 to 3 lb/ac elemental Zn. Broadcast applications should correct Zn deficiency for several years.
2. Foliar application of Zn sulfate or Zn oxide at a rate of 1 lb/ac elemental Zn or Zn chelate (Zn-EDTA) at a rate of 0.5 lb/ac elemental Zn in 20 to 50 gallons of water. **Apply only when adequate growth is present to aid in the adsorption of foliar Zn.** Foliar Zn application should be repeated if symptoms re-appear.

Boron

Boron (B) deficiency is not usually observed in this crop. If B deficiency symptoms appear, contact your county agent for assistance with diagnosis and corrective recommendations.