Small Grain-Soybeans, Double-cropped

Management Highlights

- Target pH: **6.0**
- Apply N to small grain crop only. Split applications to increase N-use efficiency.
- P and K recommendations meet the nutrient needs of **both** crops and can usually be applied in a single application.
- Monitor crop for Mn deficiency in both small grain and soybean crops, **especially** when soil test Mn is 3.4 lbs/ac or less.

Yield Goals

Grain yields of small grains and soybeans grown in double-cropped rotations are influenced by many factors, including the cultivars 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 double-cropped small grains and soybeans grown on Delaware soils in a good to average year. Irrigation use can increase soybean yields by several bushels per acre.

Table 1. Small grain and soybean yield goals as a function of soil type and irrigation use.

		Soybeans	
Soil Type	**Barley**	**Dry**	**Irr**
	--------- bu / ac ----------		
Sands, loamy sands	60 - 90	45	55
Sandy loams, loams	70 - 110	50	65
Black soils	70 - 110	50	65
Silt loams	80 - 120	50	65
		Soybeans	
Soil Type	**Wheat**	**Dry**	**Irr**
	-------- bu / ac ----------		
Sands, loamy sands	50 - 60	25	45
Sandy loams, loams	70 - 80	30	50
Black soils	70 - 90	35	50
Silt loams	90 - 110	35	50

Dry = dryland ***Irr = irrigated***

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 double-cropped small grains and 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 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 in order 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

Small Grains

Nitrogen (N) is recommended only for the small grain crop in the double-cropped sequence. The University of Delaware recommends a total N application of **60-90 lbs N/ac for barley** and **80-120 lbs N/ac for wheat** per growing season. For greatest response, N should be split into two or more applica-

tions. A small amount **(20-35%)** should be applied in the fall at planting or in late winter. The remainder **(65-80%)** should be applied in the spring when growth resumes (e.g., "green up"), preferably in two applications.

The higher N rates are recommended for sandier soils and for management systems utilizing a single application to compensate for greater leaching losses. Split applications of N have been shown to increase N-use efficiency, thus requiring less total N to achieve the same grain yield. In general, increasing N rate may increase grain production but can also increase lodging which will reduce ***harvestable*** and thus ***economic,*** yield.

When planting into fields where manure has been applied or a legume precedes the small grain crop, fertilizer N rates should be reduced. To calculate the adjustment, see ***Nitrogen Rate Adjustments -- Chapter 3, Section 3.5.1.2.***

Soybeans

Soybeans are leguminous plants and capable of fixing sufficient N to meet crop needs. Nitrogen application to soybeans is, therefore, not recommended. If soybeans have not been sucessfully grown 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 double-cropped small grain and soybeans are designed to meet the P needs of both crops and can be applied in a single application. The specific P rate selected is dependent upon the soil test P value and **the yield goal of the soybean crop**. A summary of those P recommendations are given in Table 2 below. When the soil test P index is ***Low*** (25 FIVs or less), broadcast and incorporate P in the fall. When the soil test P index is ***Medium or Optimum*** (greater than 25 FIVs), P can be topdressed in the spring or fall.

Table 2. Broadcast rates of P for double-cropped small grain and soybeans.

Soybean	P Index Value							
Yield	**0**	**10**	**20**	**30**	**40**	**50**	**70**	**90**
bu/ac	---------- lbs P_2O_5 / ac ----------							
25	140	120	100	80	60	40	0	0
30	160	140	120	100	80	60	0-20	0
35	180	160	135	115	90	70	0-25	0
40	200	180	155	130	110	90	0-40	0
45	220	195	170	145	125	100	0-50	0
50	240	215	190	160	135	110	30-60	0-30
55	260	230	200	175	145	115	30-60	0-30
60	280	250	215	185	155	120	30-60	0-30
65	300	265	230	200	165	130	30-60	0-30

Note: If P is to be band applied to the soybean crop, application rates should be reduced by half.

Potassium Management

The need for potassium (K) fertilization of double-cropped small grains and soybeans is best determined by the use of a routine soil test. As with P, K recommendations are designed to meet the K needs of both crops and are based on the expected yield of the soybean crop and the soil test K value. A summary of University of Delaware K recommendations for double-cropped small grains and soybeans is given in Table 3. Potassium can be broadcast prior to or shortly after planting. To reduce application costs, the required K for both crops can be applied as a single application to the small grain crop.

Table 3. Broadcast rates of K for double-cropped small grains and soybeans.

Soy-bean	K Index Value							
Yield	0	10	20	30	40	50	70	90
bu/ac	---------- lbs P_2O_5 / ac ----------							
25	160	140	120	100	80	60	0-20	0
30	180	160	135	115	90	70	0-25	0
35	200	180	155	130	110	90	0-40	0
40	220	195	170	145	125	100	0-50	0
45	240	215	190	160	135	110	30-60	0-30
50	260	230	200	175	145	115	30-60	0-30
55	280	250	215	185	155	120	30-60	0-30
60	300	265	230	200	165	130	30-60	0-30
65	320	285	250	215	180	145	40-75	0-40

Magnesium Management

Mg application to double cropped small grains and 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 both small grains and 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 double-cropped small grains and soybeans are given in Table 5.

Table 5. Interpretation of the Mn availability index for small grains and soybeans.

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

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 a broadcast application of 20-30 lbs/ac of actual Mn. Broadcast applications of acid-forming fertilizer, which lowers the pH in the area of plant roots, may correct Mn deficiency without the addition of Mn fertilizer but broadcast or foliar applications of Mn will be more effective.

Other Nutrients

Sulfur deficiency is occasionally observed in wheat grown on Delaware soils. Symptoms include reduced growth and a general yellowing of the plant. If deficiency is suspected, contact your county Extension agent for diagnosis and corrective action.

No other nutrients are known to be limiting to small grain or 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 small grains and/or soybeans.