FERTILIZATION AND LIMING - *(Harris)*

Soybeans remove a relatively large amount of nutrients from the soil. The approximate pounds of primary and secondary nutrients contained in a 40 bushel per acre soybean crop are shown in the following table.

Approximate Nutrient Utilization of 40 Bu/A Soybeans[1]

	Plant Nutrients Absorbed				
Plant Part	N^2	P_2O_5	K_2O	Mg	S
	lb/A				
Total Uptake	224	38	144	16	14
Seed Only	160	32	56	17	11

[1] Amounts may vary with variety, soil type, and fertilization.
[2] All N fixed from the atmosphere.

While these quantities are high, this should not be interpreted to mean that this amount of fertilizer should be added. Nutrient additions will vary according to soil type, residual nutrient status, soil pH, and past crop management. For these reasons, fertilizer needs should not be second-guessed, but based on soil test results.

Soil Testing and Recommendations

Soil tests are valuable for predicting fertilizer needs and monitoring soil nutrient status. But soil tests and the resulting fertilizer recommendations are not miracle workers. The soil test is a helpful diagnostic tool requiring common sense and experience to interpret and use in managing your fertilizer programs.

Method of Sampling

The weakest link in soil testing is the sampling procedure. Samples must accurately represent the conditions of the field or the results will be meaningless. Also, be sure to take soil samples to plow depth.

Interpreting Soil Tests

Soil pH

Low soil pH can limit soybean yields. **Liming soils for a pH near 6.0 is desirable for producing optimum soybean yields.**

Liming acid soils improves soybean yield potential by reducing toxic quantities of aluminum and manganese, favoring the growth of nodule-forming bacteria, increasing the availability of molybdenum and phosphorus, supplying calcium and/or magnesium, and improving the soil physical condition.

Limestone additions should always be based on soil test results. Adding limestone without a soil test may increase pH excessively (above pH 6.5), causing micronutrient deficiencies. The somewhat poorly drained soils of the Flatwoods in the Coastal Plain region are particularly susceptible to Mn deficiencies as soil pH increases above 6.3.

When limestone is needed, it is most effective when applied at least three months prior to planting soybeans. Since limestone is fairly insoluble and will not leach downward, it should be thoroughly incorporated throughout the plow-layer. Surface applications will have little effect on soil acidity beyond the surface two or three inches.

Fertilization

A profitable response to fertilization is more likely on a soil that tests low for a given nutrient than on one that tests high. This does not rule out the possibility of a profitable response from a fertilizer application at a high level of fertility if yield factors other than fertility are optimum. Likewise, a profitable response on soils with low fertility is not assured when other factors such as adverse climate, poor management or pest problems occur.

An example of soil test recommendations for phosphate and potash fertilizer for both full season and double-crop situations is given in the Fertilizer Recommendations for Soybeans table. Pulling a soil sample between the small grain and soybean double crop may be helpful in confirming fertility is sufficient in this system.

Fertilizer Recommendations for Soybeans

	Full Season		Small Grain - Soybean	
Soil Test Level	**P_2O_5**	**K_2O**	**P_2O_5**	**K_2O**
	lb/A			
Low	70	100	150	180
Medium	40	80	80	120
High	0	60	40	60
Very High	0	0	0	0

Nitrogen

The soybean plant is a legume, so nitrogen can be supplied by nitrogen-fixing bacteria contained in nodules located in the plant roots. These bacteria convert atmospheric

nitrogen into forms usable by the soybean plant. Total nitrogen needs can be supplied through the symbiotic nitrogen-fixation process.
For soils where soybeans have not been successfully grown within three years, an inoculant containing nitrogen-fixing bacteria should be applied at planting. Some helpful hints concerning soybean inoculation include:

- Purchase a proven soybean inoculant from a reputable dealer.
- Check the expiration date to assure viability at planting.
- Store inoculant in a cool, dry place prior to planting.
- Do not buy inoculant that is "prepackaged" with fungicide treatments.
- Do not mix inoculant and fungicide treatments far in advance of planting.
- Apply inoculant at rates and in the manner according to manufacturer recommendations.

Many producers use small amounts of nitrogen fertilizer for soybeans. While there appears to be no yield advantage under most conditions to this practice, an early season growth response may be observed. In some cases, this could permit more efficient use of early season directed herbicide applications. Nitrogen in excess of 20 pounds per acre can seriously inhibit the symbiotic nitrogen-fixation process.

Phosphate and Potash
The phosphate and potash recommendations for soybeans are based on the soil test levels as shown in the Fertilizer Recommendations for Soybeans table. Fertilization without a soil test is an unsound agronomic practice.

Soybeans are known to produce best on soils with good residual fertility. On most Georgia farms, it is desirable to maintain soil P index at a "High" test level and soil K index at a "Medium" or "High" test level. **Use soil test recommendations to determine the rate of P and K to apply to each field.**

In double-cropping systems, the phosphate and potash requirements for soybeans can be applied to the crop proceeding soybeans. On deep sands (depth to clay layer greater than 18-20 inches), the potassium application should be split, with half applied in the fall, and half applied prior to planting in the spring. The quantities recommended for a small grain and soybean systems are given in the Fertilizer Recommendations for Soybeans table.

Secondary Nutrients (Calcium and Magnesium)
For most situations, adequate levels of calcium and magnesium can be maintained by using dolomitic limestone. In situations where soil pH is above 6.0 and soil Mg tests low, it is advisable to use a magnesium fertilizer rather than additional limestone.

Micronutrients
Direct application of micronutrients to soils is seldom required for soybeans in Georgia, but should be applied when soil test results indicate levels are low. When Mn levels are low and pH is above 6.0, apply 10 lbs Mn/A as manganese sulfate or manganese oxide. Liming to pH levels greater than 6.5 can induce deficiencies of manganese, zinc and

copper on some soils. The most frequent occurrence of such deficiencies has been in the Ocilla, Pelham, Leefield, and similar soils in the Flatwoods area. Under these high pH conditions, foliar applications of micronutrients during the growing season are more effective than soil applications. Soil applied micronutrients are rapidly converted to unavailable forms in soils with high pH. A foliar spray of boron (1/4 to ½ lb/A) at soybean bloom often gives a slight soybean yield increase especially on sandy soils. Adding boron to insecticide sprays (wherein compatible) at R3 soybean growth stage can be a way of improving the economics of this treatment.

It is recommended to apply 2 oz/A Dimilin plus 1/4 to ½ lb/A boron at early podding (R2-R3) to (1) increase soybean yields, (2) control velvetbean caterpillar, (3) suppress soybean looper, (4) increase insecticide effectiveness if looper develops and (5) increase potential profitability of soybeans.

Poultry Litter

Poultry litter contains significant amounts of plant nutrients and is a valuable source of fertilizer for crop production. The nutrient content of poultry litter varies depending on a number of factors. These include moisture content, type of bird, feed rations, and handling /storage methods. The average value for N-P-K analysis of chicken litter reported by the University of Georgia Agricultural Services Laboratory is 3-2-2. Therefore, *on average*, a 1 ton/A application of chicken litter will supply 60 lbs of N, 40 lbs of P_2O_5 and 40 lbs of K_2O.

Remember, these are average values. Having litter tested for nutrient content by a reputable laboratory before calculating application rates is highly recommended.

In addition to the primary elements, poultry litter also contains significant amounts of calcium and magnesium (around 30 lbs of Ca and 5 lbs of Mg per ton of litter). This will not only supply these secondary elements for crop uptake, but may also maintain or even increase pH of the soil. Maintaining adequate soil levels of micronutrients such as Zn Mn, B, and Cu is another potential benefit of using poultry litter, since small quantities of these nutrients are contained in litter. An additional benefit of applying poultry litter to soil is a potential increase in soil organic matter. This could result in improved soil physical properties, such as tilth and water holding capacity.

The basic strategy for using poultry litter as fertilizer is to: 1) soil test, 2) test the litter for nutrients, then 3) match the nutrient requirements of the crop with nutrients in a corresponding amount of litter.

Fertilizer recommendations are normally based on the nitrogen requirement of the crop to be grown. Nitrogen is not recommended for soybeans because soybean is a legume, and nitrogen needs are met through fixation of atmospheric nitrogen by symbiotic bacteria. However, nitrogen still needs to be considered since excessive amounts can cause pollution of surface water and groundwater with nitrates. In addition, excessive N in litter applications can cause lodging. Planting shorter stemmed soybean varieties may reduce the risk of lodging in this situation. Another consideration is that not all of the

nitrogen in the applied litter will be available for uptake by the soybean. The soybean plant will have to rely on symbiotic fixation to fulfill the total nitrogen demand. Therefore, inoculating soybeans with nitrogen-fixing bacteria is still recommended if soybeans haven't been grown successfully within three years.