

lint production. Liming neutralizes soil acidity, supplies the calcium and magnesium required for plant growth and fiber production, and promotes the efficient use of other plant nutrients.

Rate and timing of nitrogen applications strongly influence cotton yield. Low nitrogen reduces yield. Too much causes excessive vegetative growth, makes pesticide coverage more difficult, delays fruiting and maturity, increases attractiveness to insects and reduces the effectiveness of defoliants.

The nitrogen rate of 50–70 lb per acre given on the soil report can be adjusted depending on soil type and expected yield potential. See section **Realistic Yield Expectation (RYE) N Rates**.

On sandy coastal plain soils where nitrogen is subject to leaching, apply 20–25 lb per acre at planting with the remainder sidedressed shortly after formation of squares. On deeper sandy soils where leaching is extensive, apply sidedressed nitrogen in split applications. Apply all nitrogen by mid-June.

In most cases, apply all recommended P₂O₅ and K₂O at planting. High-phosphate starter fertilizer (10-34-0), banded at planting, can enhance growth and maturity for cotton planted early on cool soils. Place banded starter fertilizer 2 inches to the side and 2 inches below the seed to avoid salt injury to young seedlings. On deep, sandy-textured soils where potassium leaches, consider split applications of K₂O.

Table 1. Average plant nutrients available the first year after broadcast application of animal waste *

	N	P ₂ O ₅	K ₂ O
	----- lb/ton -----		
Broiler house litter (> 6,000 samples)	29.0	26.8	40.0
Turkey house litter (> 2,500 samples)	24.2	28.0	26.6
	---- lb/1000 gallons ----		
Anaerobic swine lagoon (> 38,000 samples)	1.8	1.0	5.4
Dairy manure slurry (> 1,500 samples)	4.6	4.2	9.7

* Based on NCDA&CS waste analyses, 1999–2006.

Boron is essential for good bloom set, seed development, and fiber production. The boron recommended on a soil report (1.0 lb per acre) is for broadcast application during seedbed preparation. Alternatively, if borated fertilizer is banded, apply 0.2–0.4 lb actual B per acre. For foliar application, use 0.25 lb B per acre at early bloom followed by another 0.25 lb after two weeks. Select a highly water-soluble boron source. Monitor the boron status during the season with plant tissue analysis.

Sulfur deficiency can occur on sandy coastal plain soils where the clay is below 16 inches, particularly in seasons of excessive rainfall. Rates of 20–25 lb per acre applied along with the fertilizer safeguard against sulfur deficiency under most soil and climatic conditions. Since sulfur and nitrogen deficiencies are similar, submit plant tissue and soil samples for problem analysis and verification.

The soil report gives a sulfur recommendation whenever S-I ≤ 25. Since sulfur leaches readily, it may be adequate at the time of the report but be limiting later during the season. To monitor sulfur levels during the growing season, take plant tissue samples and send them to the NCDA&CS lab for analysis.

Realistic Yield Expectation (RYE) N Rates

More specific nitrogen rates can be used based on realistic yield expectations by soil type. These rates are required for waste and nutrient management plans in some N.C. river basins. Rates using the RYE approach are available online at nutrients.soil.ncsu.edu/yields/.

Livestock and Poultry Manures

Farm manures can be valuable sources of N, P₂O₅, K₂O (Table 1) and, in some cases, the micronutrients zinc and copper. Since nutrient content varies with rate and method of application, it is best to have the manures analyzed for nutrient content near the time of application. NCDA&CS offers a basic waste analysis for a fee of \$5.00 per sample and special tests (lime equivalence, heavy metals, nitrogen breakout) for an additional fee of \$10 per test per sample.

Repeated applications of animal waste can lead to high levels of zinc and copper within crops. Excessive levels can be toxic to plants and cause reproduction problems in livestock. Test soils regularly to determine when to discontinue application of manures for a particular site.



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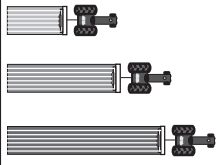
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NOTE 3:
Fertilization of
Field Crops

Lime Sources

Liming is the application of calcium or calcium-magnesium compounds that are capable of neutralizing soil acidity (raising the soil pH). Two major types of lime are used for agricultural purposes: calcitic and dolomitic. Calcitic limestone is composed of calcium carbonate (CaCO₃) and contains little or no magnesium. Dolomitic limestone is a mixture of calcium and magnesium carbonates [CaMg(CO₃)₂] and contains, by state law, 6 percent or more magnesium. Most lime sold in North Carolina is dolomitic lime. Agricultural grade lime, or ag lime, must meet specifications in fineness of grind and guarantee a neutralizing value established by state law.

Lime Rates

The rate (tons per acre) of lime recommended on the soil report should raise the pH to

- 5.0 for organic (ORG) soils,
- 5.5 for mineral organic (M-O) soils and
- 6.0 to 6.2 for mineral (MIN) soils, depending on the

crop to be grown.

The recommended rate varies depending on the level of soil acidity and the target pH for each soil type. The pH obtained with a given rate of lime varies depending on uniformity of application, particle size, neutralizing value, method and depth of incorporation, and soil texture.

When lime is recommended, apply it as early as possible to allow enough time to neutralize soil acidity. For best results, use a high-quality ag lime and incorporate it thoroughly into the top 8 inches of soil. Apply and incorporate lime prior to beginning reduced or no-till systems if possible. Maintenance applications can be surface applied.

A low soil pH is associated with low levels of calcium and/or magnesium as well as high soil acidity. As the level of soil acidity increases, aluminum increases and becomes toxic to plants. The efficiency of nutrient uptake and use decreases as well.

A high soil pH can reduce manganese availability. Manganese deficiencies may occur on sandy coastal plain soils when lime is applied in excess of the recommended rates. Therefore, follow soil test recommendations as closely as possible.

Magnesium leaches from sandy coastal plain soils. When Mg levels are adequate, 0 appears under **Mg** in the **Recommendations** section. When low, a value of 25 for **Crop 1** indicates the need for 20 to 30 lb of water-soluble Mg per acre. When a soil test recommends lime and Mg is low, dolomitic lime is the most economical source. If low and no lime is needed or calcitic lime has been used, 175 to 250 lb per acre of 0-0-22 (11.5% Mg), alone or in a fertilizer blend, will satisfy crop needs until subsequent soil testing indicates an adequate level.

Corn

The rate of N, P₂O₅ and K₂O recommended on the soil report should produce high yields as long as other factors that influence yield are optimized. These include lime needs, planting date, population, soil moisture and nitrogen management.

Nitrogen has more influence on corn yield than any other fertilizer input. Extreme variation in soil and climatic conditions across North Carolina make managing the timing and rate of application difficult. The rate recommended on the soil report (120–160 lb N per acre) can be adjusted depending on soil type and expected yield potential. See section **Realistic Yield Expectation (RYE) N Rates** for more information.

For irrigated corn, you may need to increase nitrogen rates 10 to 15 percent, particularly if the plant population is increased. This is especially true on sandy coastal plain soils where nitrogen is more subject to leaching.

Under most soil and climatic conditions, all the recommended P₂O₅ and K₂O can be broadcast before planting. However, banded starter fertilizers, such as 10-34-0 or 18-46-0, have been shown to stimulate rapid early growth and/or promote uniformity in cool, wet soils. By stimulating rapid early growth, starter fertilizers reduce the potential of billbug damage and often hasten maturity.

In general, starter fertilizers should be banded at the rate of 20–40 lb of N and P₂O₅ per acre, two inches to the side and two inches below the seed at planting. The P₂O₅ applied as a starter should be subtracted from the total P₂O₅ recommended. The total N and K₂O applied in a band should not exceed 70–80 lb per acre to avoid salt injury to seedling plants.

Sulfur deficiency may occur on sandy coastal plain soils following periods of excessive rain or heavy irrigation, especially when the subsoil is deeper than 16 inches. Although less likely, levels of plant-available sulfur can also be limiting in organic soils.

The soil report gives a sulfur recommendation whenever S-I ≤ 25. Since sulfur leaches as readily as nitrogen, it may be adequate at the time of the report but be limiting later during the season. Plant tissue analysis can be used in-season to test for sufficiency.

Soybeans

On most soils, the P₂O₅ and K₂O recommended on the soil report can be applied before planting.

Manganese deficiency on soybeans is commonly observed on sandy coastal plain soils when the pH exceeds 6.2. Therefore, never apply more lime than recommended on the soil report. If a Mn deficiency occurs due to overliming, the *Note* offers advice on dealing with this problem.

Manganese deficiency is also prevalent on some sandy coastal plain soils due to the inherently low Mn levels in these soils. When low Mn is confirmed by a soil test, broadcast 10 lb of water-soluble Mn per acre before lime is applied. This rate should supply the Mn requirement of plants for several years.

Soybeans heavily infested with cyst nematodes may show symptoms much like manganese deficiency. Consequently, fields with a history of cyst nematodes should be analyzed for nematodes as well as for soil and plant tissue nutrient levels.

Double Crop: Small Grain/Soybeans

Apply only the recommended rates of lime to avoid raising the soil pH too much. Manganese deficiency is common when the pH is 6.2 or higher, particularly on sandy coastal plain soils. This deficiency has adverse effects on yields of small grains and/or soybeans. If a deficiency occurs, follow the advice in the *Note*.

For small grains grown on sandy coastal plain soils where nitrogen is subject to leaching, apply 20–30 lb N per acre at planting with the remainder topdressed in late February or early March. On heavy-textured soils of the piedmont and mountain regions, apply one-third at planting and topdress with the remainder in late February or early March. See section **Realistic Yield Expectation (RYE) N Rates** for more information.

Apply the recommended P₂O₅ and K₂O prior to planting. In most cases, the P₂O₅ and K₂O recommended for double-cropped soybeans can be applied to the preceding small grain crop. The feasibility of this practice depends upon the capacity of individual soils to hold phosphorus and potassium against leaching.

Phosphorus leaches from soils high in organic matter with little or no mineral component. Therefore on these soils, apply any recommended P₂O₅ directly to the soybean crop.

Potassium leaches from sandy coastal plain soils with a low cation exchange capacity. On these soils, apply recommended K₂O directly to the soybeans.

On soils that have the capacity to hold phosphorus and potassium, the rate of P₂O₅ and K₂O recommended for soybeans following small grain can be reduced by one-half and applied with the P₂O₅ and K₂O recommended for the small grain crop.

Sulfur deficiency may occur on small grains, especially on deep sandy soils after leaching rainfall. Deficiency is particularly likely when the subsoil is deeper than 16 inches and when no sulfur has been applied to the previous crop.

The soil report gives a sulfur recommendation whenever S-I ≤ 25. Since sulfur leaches readily, it may be adequate at the time of the report but be limiting later during the season. To monitor sulfur levels during the growing season, take plant tissue samples and send them to the NCDA&CS lab for analysis.

Double Crop: Small Grain/Grain Sorghum

Use the nitrogen recommendations on the soil report as a guide. Fertilize with P₂O₅ and K₂O as described for soybeans double-cropped behind small grain.

Peanuts

Lime is essential for successful peanut production. It is a major source of calcium and magnesium, boosts the efficiency of nutrient uptake and use, promotes nodulation and nitrogen fixation and reduces the potential of aluminum toxicity. The pH range for optimum peanut production is from 5.8 to 6.2.

Landplaster (gypsum) is often used as a source of calcium. When applied to extremely acid soils (pH < 5.0), it can raise aluminum levels within the root zone, resulting in poor growth and reduced yields and quality. This problem can be prevented by using lime instead of landplaster.

Large-seeded, Virginia-type peanuts require a high calcium content in the soil surface at pegging for pod development and production of quality peanuts. Landplaster applied in late June to mid-July in either of the following ways meets this requirement:

- 600–800 lb per acre of finely ground gypsum applied in a 16- to 18-inch band over the row at first bloom;
- 1200–1500 lb per acre of granular gypsum or 1800–2000 lb per acre of by-product gypsum broadcast.

The acidity associated with by-product gypsum requires that soil pH be monitored more frequently.

Excessive potassium can be detrimental to a peanut crop. High levels within the fruiting zone (top 2–3 inches of soil) are associated with pod rot. Potassium also competes with calcium uptake at pegging, resulting in a high percentage of “pops.” Therefore, apply any potash (K₂O) recommended for the peanut crop along with the preceding crop’s fertilizer. If this cannot be done, apply and incorporate the recommended K₂O as far before planting as possible to allow enough time for potassium to move below the fruiting zone before pegging.

Apply any recommended P₂O₅ in one of two ways: along with fertilizer for the preceding crop, or directly to the peanut field prior to planting.

Manganese deficiency may occur when the soil pH exceeds 6.2. If you suspect a manganese deficiency, collect soil and plant samples and have them analyzed. The *Note* provides advice on this problem.

Peanuts are extremely sensitive to zinc. Toxicity, and sometimes plant death, may occur when the zinc-availability index (Zn-AI) is 250 or greater. Establishing a pH of 6.0 or higher minimizes risk of zinc toxicity. See the *Note* for details.

The amount of boron recommended on a soil report (0.5 lb B per acre) prevents hollow heart in peanuts. Boron can be applied as a preplant broadcast treatment along with other fertilizer applications, or with the preplant incorporated herbicide application. Alternatively, apply 0.25 lb B per acre as a foliar spray near blooming and prior to fruiting. Apply another 0.25 lb two weeks later. The total rate of boron should not exceed 0.5 lb per acre.

Cotton

A soil pH near 6.2 is essential for the production of high-yielding, quality cotton. Cotton is very sensitive to soil acidity and has a high calcium requirement for quality