W 1033

UT SOIL FERTILITY RECOMMENDATIONS FOR COTTON

Nutifafa Adotey, Assistant Professor and Soil and Nutrient Management Specialist, Department of Biosystems Engineering and Soil Science
Tyson B. Raper, Associate Professor and Cotton and Small Grain Specialist, Department of Plant Sciences
Lori Duncan, Assistant Professor and Row Crop Sustainability Specialist, Department of Biosystems Engineering and Soil Science

PLANNING TO GET THE MOST OUT OF YOUR CROP?

Developing a good soil fertility program is pertinent to achieving this desired goal. A good soil fertility program should combine a soil testing program with crop production records to make informed nutrient management decisions. In-season tissue testing also complements a soil testing program. Applying fertilizer in accordance to soil test recommendations can help to maximize the return on fertilizer investment and minimize environmental damage. This publication provides a brief look into the University of Tennessee's current soil fertility recommendations for cotton production.

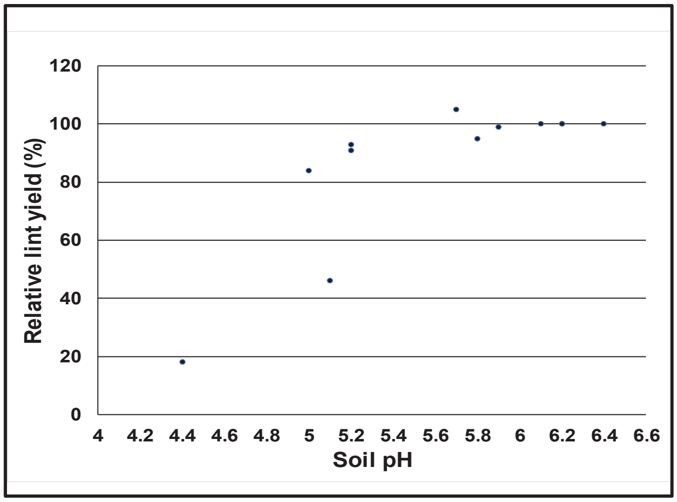
1. Soil testing

- The only practical way to determine the nutritional needs in a field and to prescribe appropriate lime and fertilizer recommendations is with a reliable soil test.
- Although soil samples may be collected at any time, it is best to sample months ahead of planting to allow for proper planning.
- Collect representative soil samples using proper sampling procedures. Information sheet, submission sheets and sample boxes are available at your county UT Extension office.
- Go to UT Soil Plant and Pest Center for additional information.

2. Liming and soil pH

- Cotton performs best when soil pH is from 5.8 to 6.5. Soil pH influences the availability of plant nutrients for plant uptake.
- Fertilizers are more efficient when soil pH is maintained between 6-7.
- Soils with pH less than 5.8 decrease the availability of several nutrients, thus resulting in significant yield penalty (Figure 1).
- Liming is recommended for fields with soil pH less than 6.0. Apply lime based on soil test results to prevent over application, which may result in phosphorus and some micronutrient deficiencies.
- If liming is necessary, fields should be limed at least four months prior to planting to allow enough time for a pH change in the soil, especially in the no-till production system.

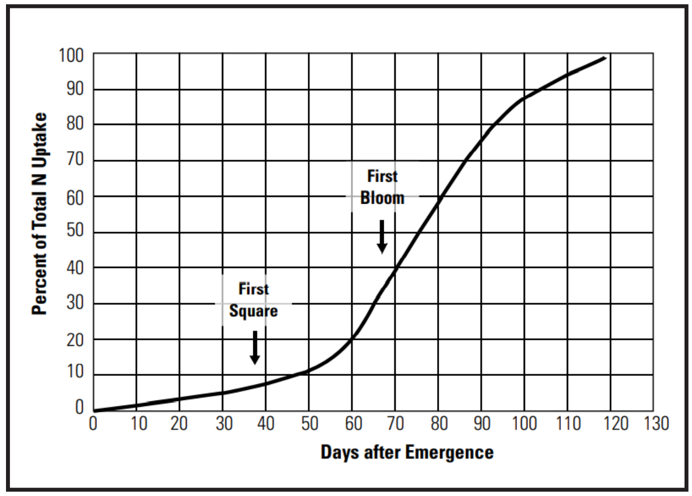
Figure 1. Effect of soil pH on lint yield. Source: Gascho and Parker, 2001



3. Nitrogen

- Nitrogen (N) management is very critical in cotton management. Excessive or under application of N can cause significant yield loss.
- The recommended practice is to sidedress N just before early square, which is closer to the period of substantial nutrient demand by the cotton plant (Figure 2).
- Current recommendation for N application on cotton production in Tennessee is to apply 60-80 pounds N per acre on upland soils.
- Variety of nitrogen fertilizer sources are available (Table 3). Growers should choose a source that fits well with their operation based on availability, price and compatibility to their operation. However, urea-based N fertilizers are more susceptible to ammonia loss when compared to other N sources. Hence, treating or adding an N stabilizer to urea-based N fertilizer is recommended if at least one-fourth inch rainfall is not forecasted within two days after N application.
- Broadcasting and surface banding are the common placement methods. Surface band applications minimize N loss as ammonia.

Figure 2. Timing of N uptake by cotton. Source: Luke Gabion, 2020



4. Phosphate, potash, sulfur (S) and boron (B)

- In addition to N, Phosphorus (P), Potassium (K), Sulfur (S) and Boron (B) are nutrients of importance in cotton that must be managed properly for optimum fiber quality and lint yield.
- Management of these nutrients should be based on soil test results and field production records.
- Broadcast soil applications are recommended for P, K, S and B fertilizers. Boron fertilizer can be applied as a foliar application during bloom.

5. Phosphate and potash

Potash fertilizer is used in the greatest amount in cotton production. Phosphate and potash recommendations for cotton production in Tennessee is presented in Table 1.

Table 1. Soil test interpretation, phosphate and potash recommendations for cotton production in Tennessee (Savoy H.J. and D. Joines).

Rankings	Soil test P (lbs. P a^{-1})		Application rates	Soil test K (lbs. K a^{-1})		Application rates
	Mehlich-I	Mehlich-III	(lbs. P_2O_5 a^{-1})	Mehlich-I	Mehlich-III	(lbs. K_2O a^{-1})
Low	0 -18	0 - 30	90	0 - 140	0 - 178	120
Medium	19 - 30	31 - 60	60	141 - 280	179 - 356	90
High	31 - 119	61 - 210	0	281 - 319	357 - 405	0
Very High	Greater than 120	Greater than 211	0	Greater than 320	Greater than 406	0

6. Sulfur

Apply **10 pounds of S per acre** onto soils with low organic matter and coarse-textured subsoils or a field with history of deficiency from either visual symptoms or plant tissue test.

7. Boron

For soil application, apply **one-half pound of boron** per acre when soil pH is 6.0 or in recently limed fields. For foliar application, apply 0.1 pound of boron 3-5 times during bloom.

8. Visual nutrient deficiency symptoms, common causes of nutrient deficiency and common fertilizer source for N, P, K and S.

9. Plant tissue testing

- Plant tissue testing is a management tool to diagnose nutrient deficiency and monitor the nutritional status of crops. Based on this testing, timely corrective in-season or preventive action in subsequent season can be taken to improve the crop's nutrient status and productivity.
- The most commonly used method for interpreting tissue testing in cotton are sufficiency ranges (range of nutrient concentrations that are considered adequate for potential yields). However, ranges serve as guidelines since values slightly outside this range may not limit plant growth or yield. Nutrient deficiencies are diagnosed when nutrient concentrations of a recently matured cotton leaf blade at early or late bloom growth stages fall below the lower limits of the sufficiency range listed in Table 2.
- Plant tissue analysis does not identify the potential factors that contribute to nutrient deficiency." Soil test alone will also not provide the potential factors that contribute to nutrient deficiency. You need both, plus management history, to better understand the cause of nutrient deficiency. Some common causes of nutrient deficiency and common fertilizer sources for N, P, K and S are provided in Table 3.

Table 2. Nutrient sufficiency ranges for recently matured cotton leaf blade at early and late bloom growth stages (Source: Campbell, R. 2013).

Growth Stage	N	P	K	Ca	Mg	S	B	Fe	Mn	Cu	Zn
	%						ppm				
Early bloom	3.0 - 4.5	0.2 - 0.65	1.5 - 3.0	2.0 - 3.5	0.3 - 0.9	0.25 - 0.8	20 - 80	50 - 250	25 - 350	5 - 25	20 - 200
Late bloom	3.0 - 4.5	0.15 - 0.6	0.75 - 2.5	2.0 - 4.0	0.3 - 0.9	0.3 - 0.9	15 - 200	50 - 300	10 - 400	-	50 - 300

Table 3. Some common causes of nutrient deficiency and common fertilizer source for N, P, K and S.

Nutrient	Some common causes	Common fertilizer sources
Macronutrients		
Nitrogen (N)	• Cold soils • Under application of N fertilizers • Excess nitrogen loss via leaching, ammonia volatilization, denitrification or runoff.	Urea (46 percent); urea ammonium nitrate (28 - 32 percent); anhydrous ammonia (82 percent); ammonium sulfate (21 percent), ammonium nitrate (34 percent); calcium ammonium nitrate (27 percent).
Phosphorus (P)	• Cold soils • Soil compaction • Side wall compaction	Triple superphosphate (45 percent); di-ammonium phosphate (46 percent); mono-ammonium phosphate (52 percent); ammonium polyphosphate (37 percent).
Potassium (K)	• Drought • Compacted soils • Sidewall compaction • Potassium stratification	Potassium magnesium sulfate (22 percent); potassium sulfate (50 percent); potassium nitrate (44 percent); muriate of potash (60 percent).
Sulfur (S)	• Sandy soils • Soils with low organic matter	Ammonium sulfate (24 percent); potassium sulfate (17.6 percent); gypsum (16.8 percent); zinc sulfate (17.8 percent); elemental sulfur.

Figure 3. Healthy leaf (left) and an N deficient leaf (right). Nitrogen deficient leaves are pale or yellowishgreen in color with reduced leaf size. Photo from CDFA.

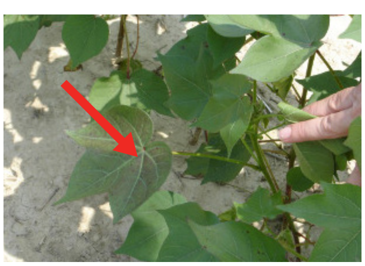


Figure 4. Cotton plant with a P deficient leaf. Phosphorus deficient leaves are dark green in color and may turn reddish-purple as shown in the picture above. Photo from CDFA. Potassium (K) deficiency.

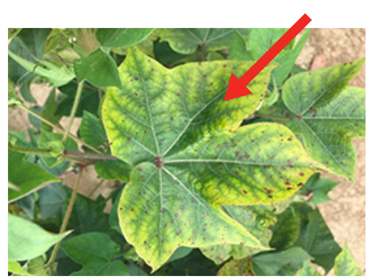


Figure 5. Cotton plant with a K deficient leaf. Potassium deficient leaves with interveinal chlorosis, beginning from the leaf tip and margins. Photo courtesy of Tyson Raper.

Figure 6. Cotton plants with healthy leaves (left) and S deficient leaves (right). Sulfur deficient leaves are pale or yellowish-green in color with reduced leaf size. Photo courtesy of Tyson Raper.

10. Resources and further reading

- Campbell R.A. 2013. Reference Sufficiency Ranges for Plant Analysis in Southern Region of the United States.
- Duncan L.A and T.B. Raper. 2019. Cotton Nitrogen Management in Tennessee. UT Extension, W 783
- Gabion, L. 2020. Fertilization: 2020 Cotton Information. N.C. Cooperative Extension
- Gascho, G.J. and M.B. Parker, 2001. Long-Term Liming Effects on Coastal Plain Soils and Crops. Agron. J. 93(6)
- Raper, T.B., A.T. McClure, F. Yin and B. Brown. 2014. Sulfur and Tennessee row crops. UT Extension, W435
- Savoy H.J. and D. Joines. Lime and Fertilizer Recommendations for the Various Crops of Tennessee.
- Southern Cooperative Series Bulletin #394.NCDA and CSA Division, Raleigh, NC

UTIA INSTITUTE OF AGRICULTURE
THE UNIVERSITY OF TENNESSEE

UTIA.TENNESSEE.EDU
Real. Life. Solutions.™

W 1033 9/21 22-0031 Programs in agriculture and natural resources, 4-H youth development, family and consumer sciences, and resource development. University of Tennessee Institute of Agriculture, U.S. Department of Agriculture and County governments cooperating. UT Extension provides equal opportunities in programs and employment.