Soil Fertility in Cotton Production

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Soil Health, an Integrated Approach

• More than just applying fertilizer

• Includes:
  • Setting realistic yield goals
  • pH of the soil
  • When to apply fertilizer?
  • What fertilizer to apply?
Soil Health, an Integrated Approach

• (List continued):
  • Managing nutrient loss
  • Compaction
  • Root penetration
  • Water infiltration and drainage
Setting Realistic Yield Goals

• Base your goals on field history

• Too little:
  • Reduced yields
  • Unrealized economic potential

Justus von Liebig (1803-1873)
Setting Realistic Yield Goals

• Base your goals on field history

• Too much:
  • Excess nitrogen - excess vegetative growth, lower yield
  • Other nutrients may be wasted
Soil pH

• Ideal is 6.0 to 6.5
• Cotton does quite well between 5.8 and 8.0
• Liming the soil helps to lower pH
  • Follow soil-test recommendations
• Remember, nutrient availability is pH dependent
Soil pH

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Soil pH

• If the ideal pH is not possible, then what?
  • Foliar applications may work
  • Dictated by economics!
When to Apply Fertilizer

• Ideal: apply when the plant needs it
• Usually not possible
• Depends on irrigation system
• Mobility of the nutrient in the soil
When to Apply Fertilizer?

• Nitrogen (N)
  • Soil test gives a good estimate of available N
  • Soil testing recommended every 3 years
  • If the field has a history of inadequate or excess vegetative growth, change N applications accordingly
  • Peak demand at fourth week of flowering
  • Need 40 lb. N per bale of yield
When to Apply Fertilizer?

• Nitrogen (cont.)
  • Applications over 100 lb. N:
    • Boron is often needed
    • Insects are a bigger problem
    • Excess Vegetative growth
  • At the end of the season you want the plant starved of N
When to Apply Fertilizer?

- Nitrogen (cont.)
  - Apply 1/3 N at time of planting
  - Ideal: banded 2-4in. below and to the side of the seed
  - Apply 1/3 at first square
  - Apply 1/3 at first bloom
  - Apply less when following legume crops
When to Apply Fertilizer?

• Nitrogen (cont.)
  • Too much N causes problems:
    • Delayed maturity
    • Defoliation problems (late season)
    • Regrowth after defoliation
    • Damaged fiber quality
    • Reduced yields
  • Excessive vegetative growth
  • More pest damage
  • Delayed maturity
  • Delayed boll opening
Phosphorus (P)

- Immobile in the soil, so apply all at time of planting
- Important nutrient for seedling growth
- Sandy soils may need supplemental P foliar application for high yield
- Cotton takes up P slowly in cold soils (solubility, slow root growth & slow mycorrhizae growth)
Potassium (K)

• Fairly mobile in the soil so split application
• Peak demand 4\textsuperscript{th} week of bloom
• Can apply ½ at planting and ½ side dress
• Sandy soils may need supplemental P foliar application for high yield
Other Nutrients

• Calcium (Ca) and magnesium can be supplied by liming

• Sulfur (S) requirements are difficult to assess. Low OM or sandy soils may need S

• Boron (B) is especially important with high N applications (100lb./A+)
Other Nutrients

• Sulfur
  • In the past S was not an issue because we burned high-sulfur coal
  • Farmers depended on rain dissolving it from the air (30+ lb/A)
  • Clean air act of 1970 reduced S emissions. Now below 20lb/A)
  • Another source of sulfur is decaying OM
    • Low OM soils tend to be low in S
    • Sandy soils are often low in OM
Other Nutrients

• Boron (B) can be applied to the soil or foliar
  • Higher rates required for soil applications (1-2 lb/A)
  • 0.1 lb/A applied weekly during early bloom (3 to 5 times)
    • B is not mobile in the plant, hence multiple applications
  • Rates of 0.5 or more burns the leaves
  • Compatible with many insecticides
  • B is more difficult to manage when:
    • Low organic matter (OM)
    • Excess lime
    • Sandy soil
### Other Nutrients

- **Boron**

![Nutrient Graph](image.png)
Petiole Analysis (Blade Analysis)

• Most accurate way of monitoring nutrient levels during the season
• Petiole analysis done on the top-most fully expanded leaf (4 leaves below the expanding leaf that is 1” across)
Managing Nutrient Loss

• Split applications of mobile nutrients
• Add urease inhibitors (Agrotain®) with urea
  • Almost doubles N utilization from urea
• Do not apply fertilizer when soil is wet
  • Runoff, leaching, denitrification
• Consider owning your own application equipment
  • More control over timing of applications
Compaction Effects

• Reduced air/water space in soil
• Water infiltration rates are reduced
• Increased soil erosion
• Poor root development
  • Affects water and nutrient uptake
• Denitrification of nitrates (anaerobic conditions)
Reduce Compaction

• No operations on wet fields (tillage, spray, fertilize, etc.)
• Reduce # of operations
• Drive the same rows for each operation
Take-home lessons

• Do not apply too little fertilizer
• Do not apply too much fertilizer
• Timing is important
• It is more than just NPK
• IT IS ALL ABOUT ECONOMICS!
References

Albers, DW. 1993. Fertility management of cotton. Univ. of Mo. Extension
http://extension.missouri.edu/p/G4256


Kissel, DE, G Harris. University of Georgia Field Crop Sheets.

http://extension.missouri.edu/p/G4257

Integrated crop management: Soil fertility. National Cotton Council
https://www.cotton.org/tech/ace/soil-fertility.cfm