NC STATE UNIVERSITY

Peanut Fertility

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General Production Practices

- Apply nutrients based on soil test (pH 5.8 to 6.2)
- Avoid excessive Mg and K
- Avoid fields with zinc
- Establish good rotations (cotton, corn, sorghum)
- Plant a disease-resistant variety in May at a 2-inch depth
- 5 plants per foot of row on 36-inch rows
- Conventional tillage
- Inoculate with *Bradyrhizobia* for BNF
- Apply calcium at pegging
- Apply boron and manganese as needed
- Dig based on pod mesocarp color
- Control pests using IPM practices

Major Nutrients Required by Peanut

Element	Consideration
Nitrogen	Inoculation (Rhizobium)
Phosphorus, Potassium, and Magnesium	Potassium and magnesium interference with calcium
Calcium	Pod development
Manganese	pH dependent
Boron	Pod development
Zinc	Toxicity at low pH
Lime	5.8 to 6.2

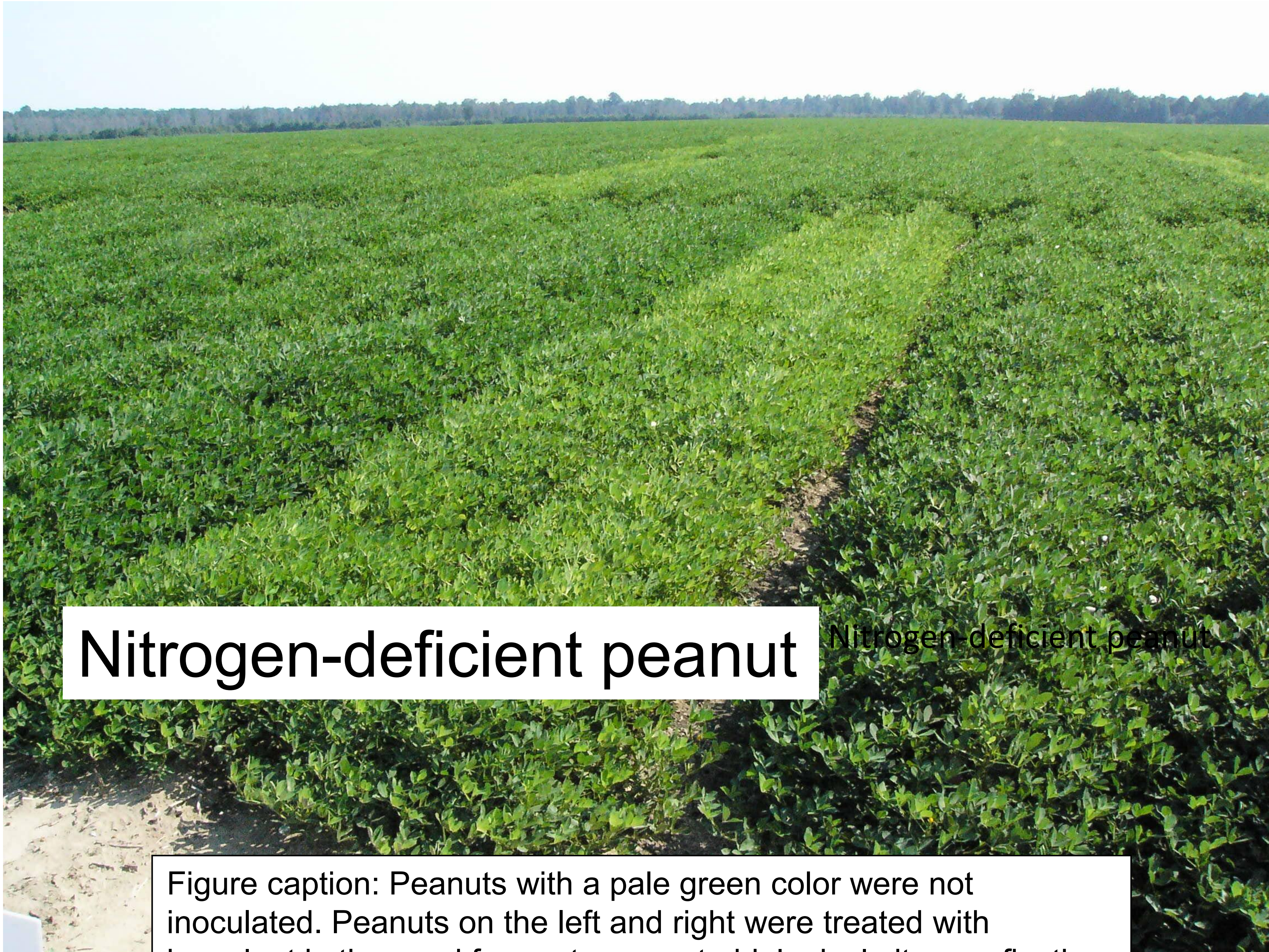


Figure caption: Peanuts with a pale green color were not inoculated. Peanuts on the left and right were treated with inoculant in the seed furrow to promote biological nitrogen fixation

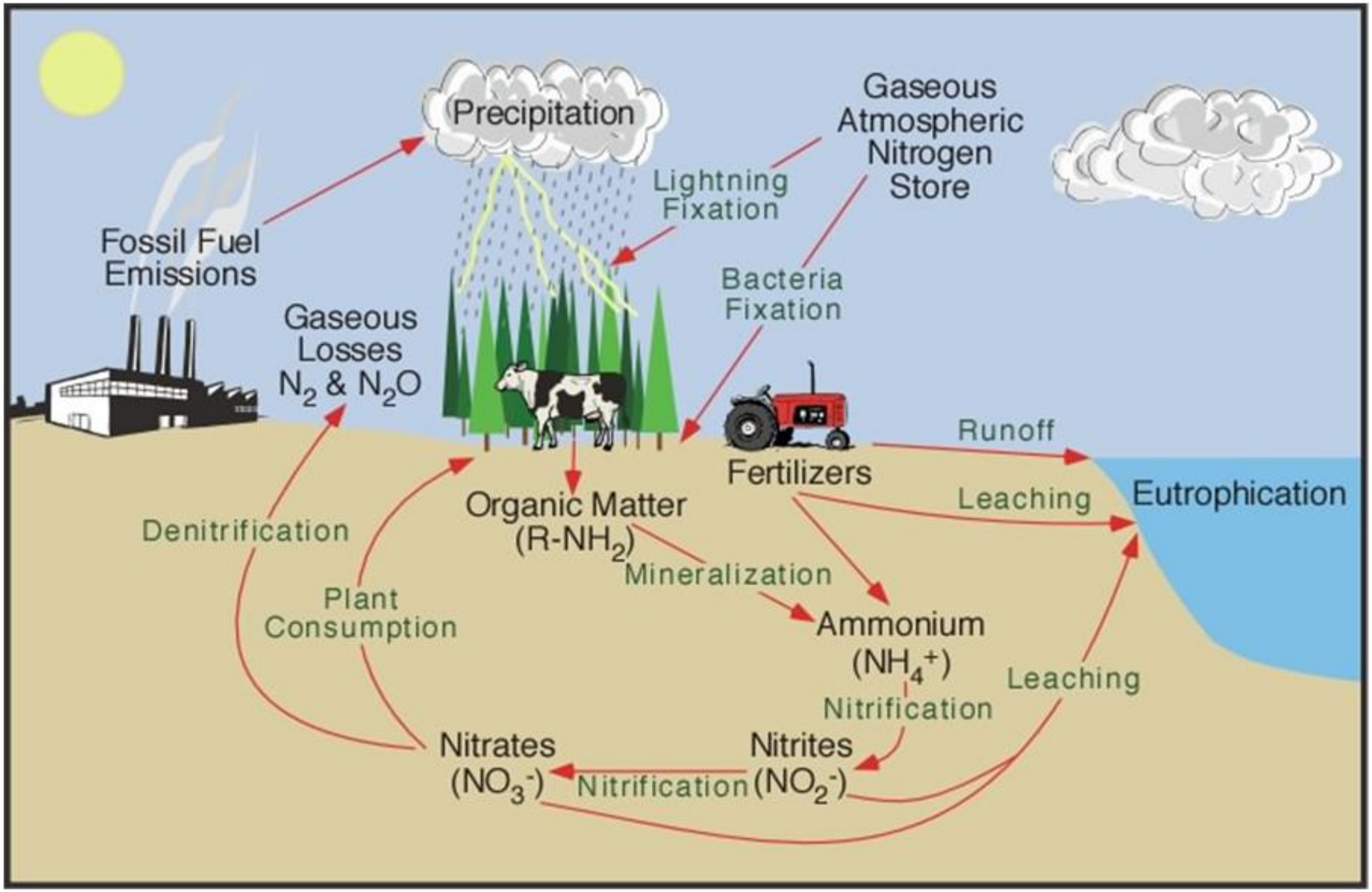
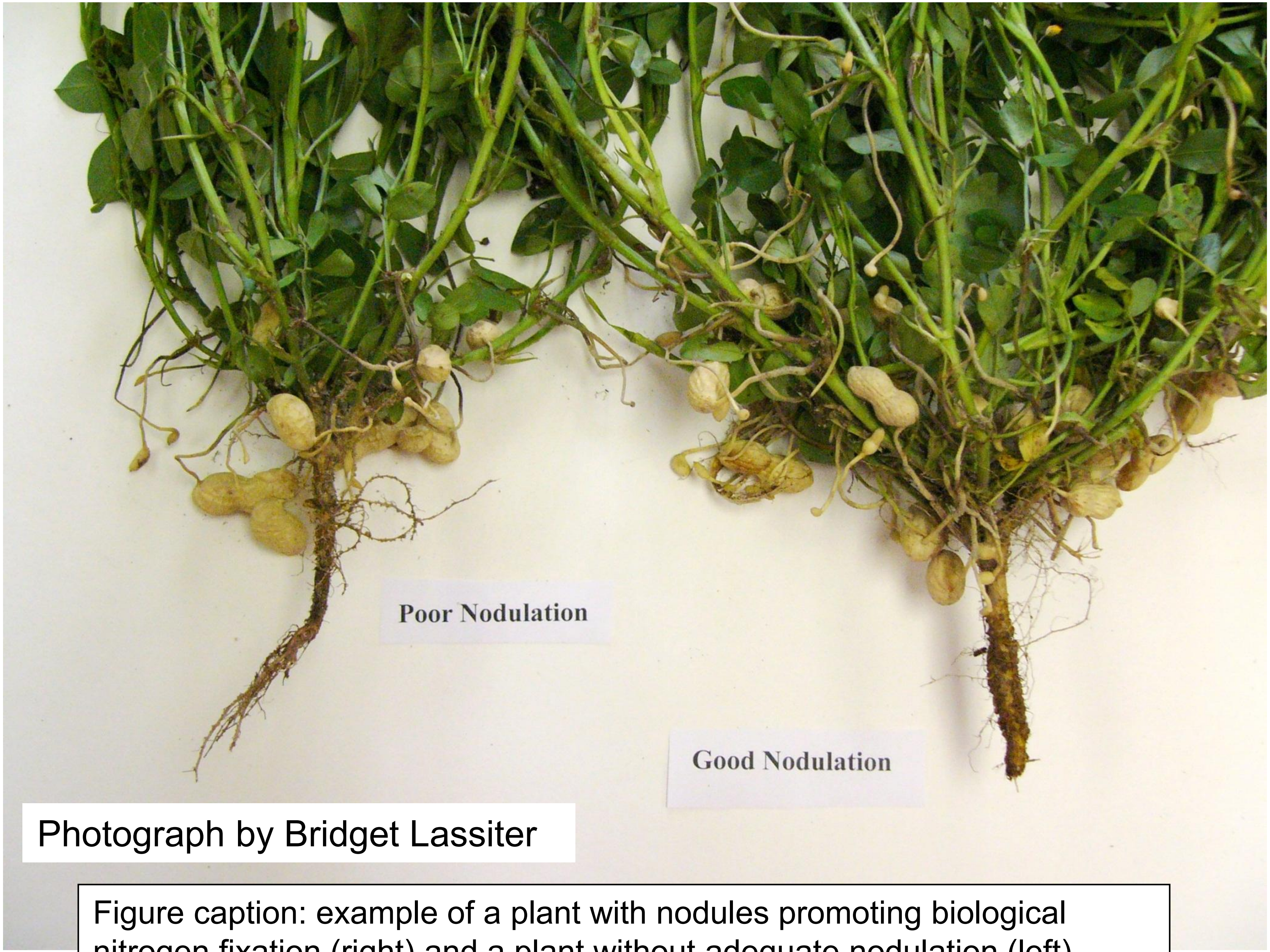


Figure 9s-1: Nitrogen cycle.

Citation: Pidwirny, M. (2006). "The Nitrogen Cycle". *Fundamentals of Physical Geography, 2nd Edition*. Date Viewed. http://www.physicalgeography.net/fundamentals/9s.html

Figure caption: Diagram of the nitrogen cycle

Figure caption. Nodules in a symbiotic relationship with the plant resulting in conversion of atmospheric nitrogen into a plant usable form



Photograph by Bridget Lassiter

Figure caption: example of a plant with nodules promoting biological nitrogen fixation (right) and a plant without adequate nodulation (left)

Figure caption: peanut root system with abundance of nodules

Photograph by Bridget Lassiter

Figure caption: cross section of nodule with a deep red or rust color indicating excellent nodule activity

Inoculant Sources

In-furrow granular

In-furrow sprays

Hopper Box treatments

“Native” inoculum

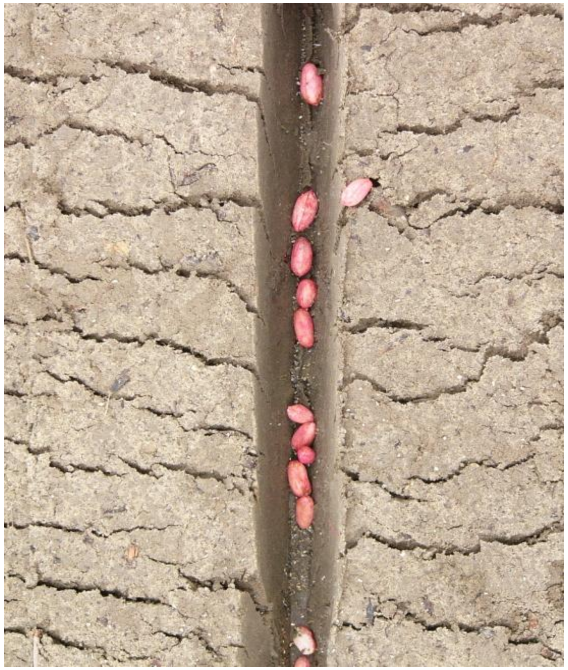


Figure caption: tractor and planter unit (top left) and seed furrow with peanut seed (bottom right)

Table 3-5. Peanut Yield Response and Economic Return at a Price of $535 per Ton in Fields Without a History of Peanuts Versus Fields With Frequent Plantings of Peanuts

Inoculant Use	New Peanut Fields		Fields with a Recent History of Peanuts	
	Yield (lb per acre)	Economic return ($ per acre)	Yield (lb per acre)	Economic return ($ per acre)
No Inoculant	3,460	5	4,280	227
Inoculant	4,660	323	4,450	268
Difference	1,200	318	170	41
Number of Trials	52	52	43	43
Years	1999 – 2017		1999 – 2017	

Table 3-6. Peanut Response from 14 Trials to Inoculation and Ammonium Sulfate at 571 lb/acre (120 lb actual N/acre) Applied when Nitrogen Deficiency Is First Visible

Inoculant	Ammonium Sulfate	Pod Yield (lb/acre)	Net Return ($/acre)
No	No	3,530 c	20 c
Yes	No	4,850 a	353 a
No	Yes	4,550 b	271 b

Means followed by the same letter are not significantly different at $p < 0.05$.

Standard recommendation on every acre of peanuts

Apply in-furrow inoculant spray AND add peat-based inoculant to seed

Figure caption: peanut rows that are pale green did not receive inoculant in the seed furrow while the two rows in the center of the image did receive inoculant at planting

Figure caption: example of peanut row that is pale green that did not receive inoculant in the seed furrow at planting

Poor Performance of *Bradyrhizobium*

Old product or “mistreated” product

Non-uniform application

Poor water quality

Caving in of planter slit before application but after seed drop

Incompatibility with other agrichemicals or fertilizers

Mixed in tank too long prior to application

Shallow planting

Equipment delivery

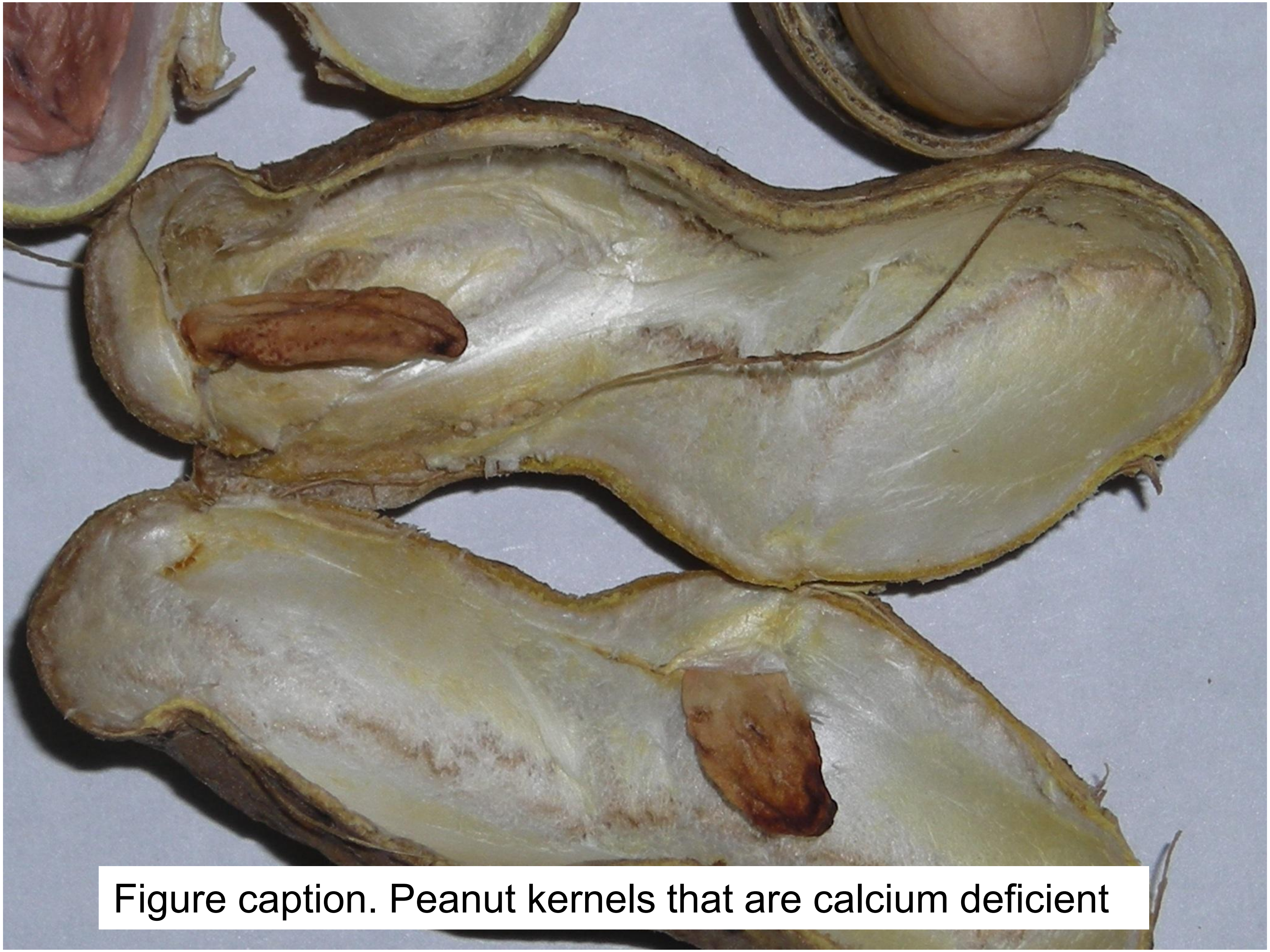


Figure caption. Peanut kernels that are calcium deficient

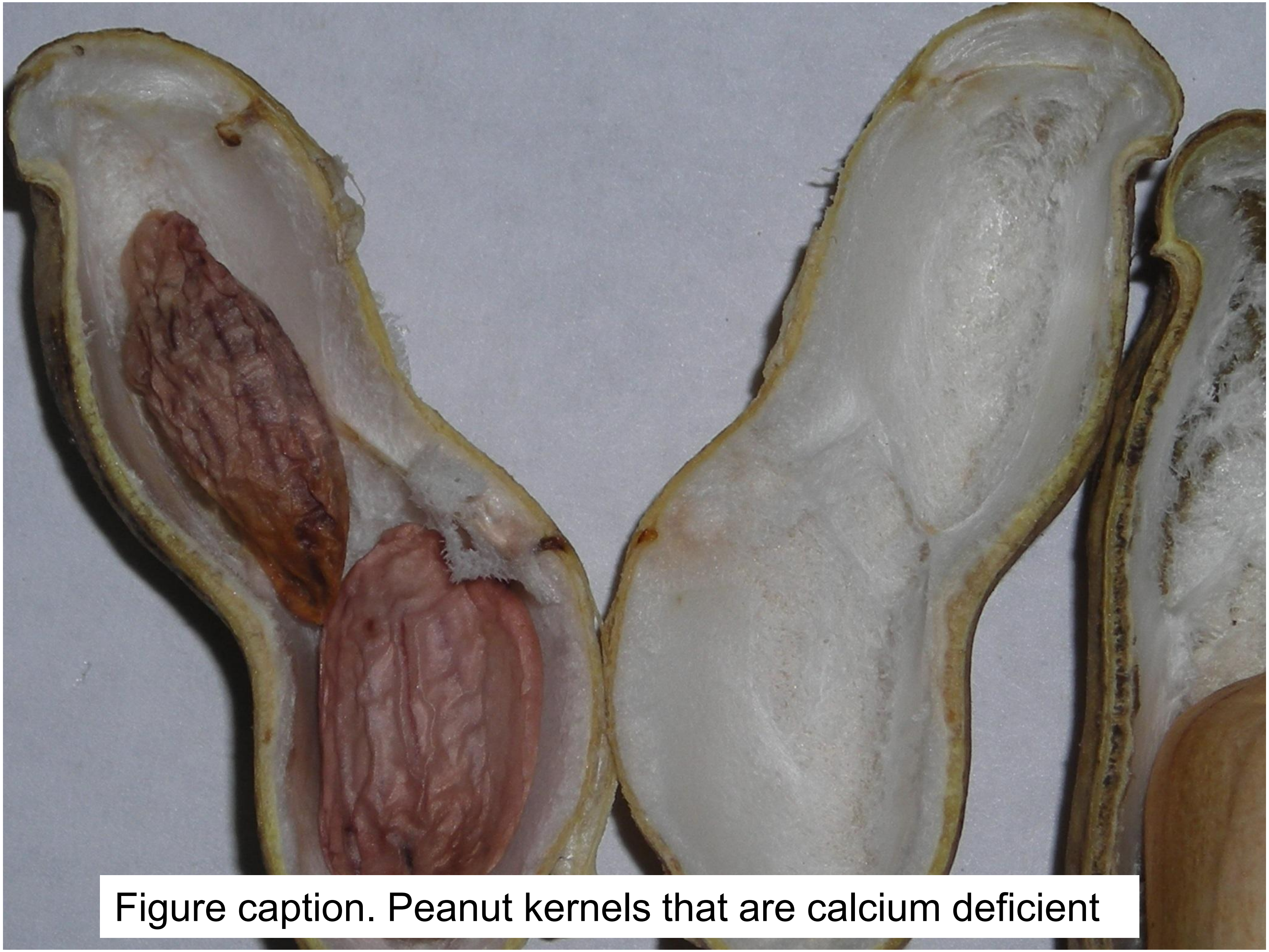


Figure caption. Peanut kernels that are calcium deficient

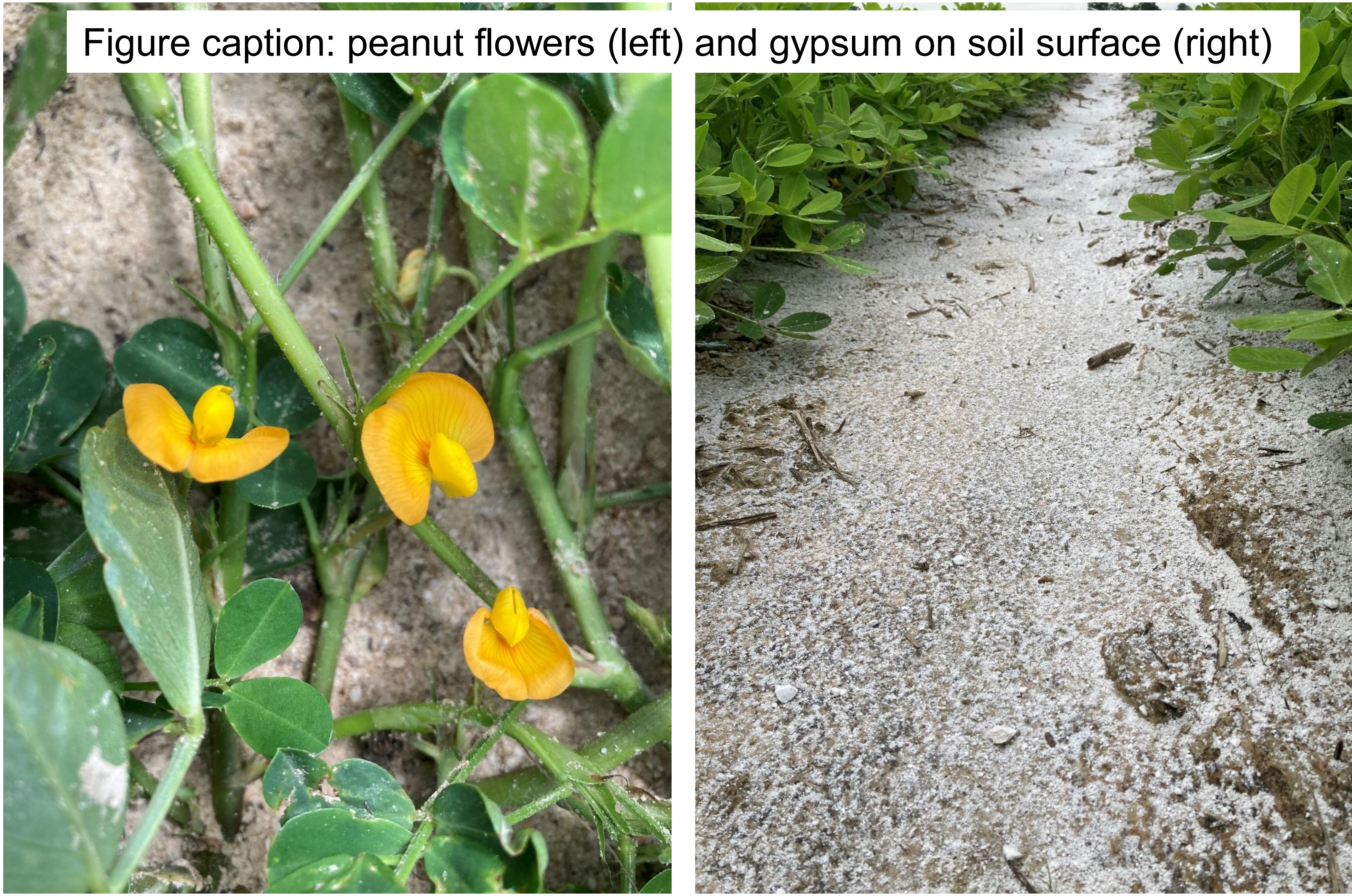


Figure caption: peanut flowers (left) and gypsum on soil surface (right)

Calcium Sulfate

Adequate kernel development

Photo credits: David Jordan

Factors that Affect Peanut Response to Gypsum

- Seed size
- Rainfall or irrigation
- Soil texture and organic matter
- Soil pH
- Nutrient balance

Table 3-7. Pod Yield Following Application of Gypsum at 0.5 and 1 Times (X) the Recommended Use Rate for Virginia Market Types.

Pod Yield (lb/acre)	No. of Trials	Pod Yield (lb/acre)		
		No Gypsum	0.5X Gypsum	1.0X Gypsum
Actual yield	12	3,970	4,510	4,590
Increase in yield over no-gypsum control	—	—	540	620

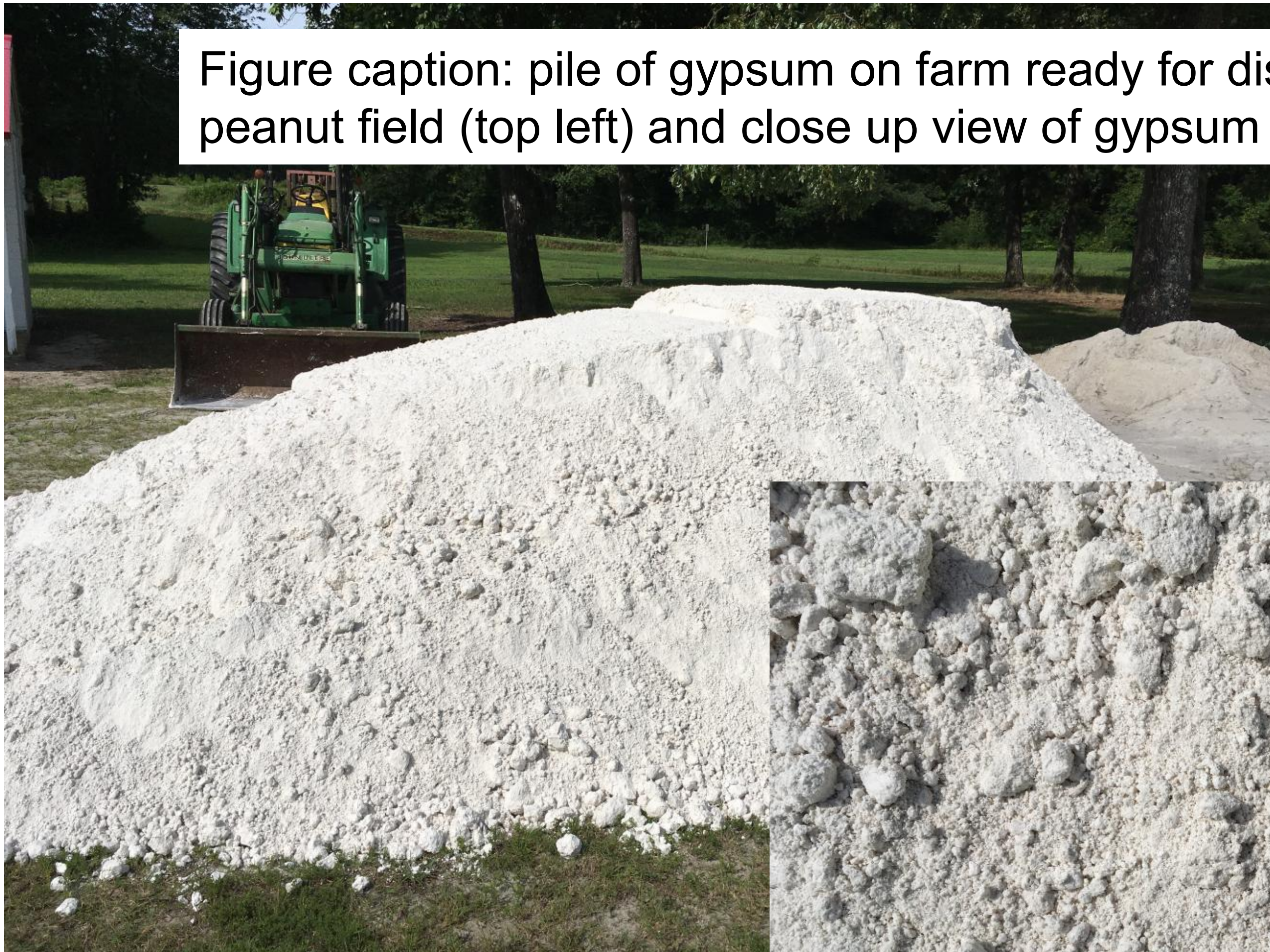


Figure caption: pile of gypsum on farm ready for distribution in peanut field (top left) and close up view of gypsum (bottom right)

Table 3-6. Gypsum Sources and Application Rates

Source	% $CaSO_4$*	Application Rate (lb/acre)	
		Band (16 – 18 in)	Broadcast
USG Ben Franklin	85	600	—
USG 420 Granular	83	—	1,215
USG 500	70	—	1,300
Super Gyp 85	85	—	1,200
TG Phosphogypsum	50	—	2,000
Agri Gypsum	60	—	1,800
Gyp Soil	85	—	1,200

*Guaranteed analysis percentage in registration with North Carolina Department of Agriculture and Consumer Services.

Table 3-8. Amount of Liquid Product Needed to Provide Equivalent Amounts of Elemental Calcium per Acre

Source	Amount of Product Needed to Supply the Equivalent Amount of Calcium per Acre
USG 500 (gypsum, 21% calcium)	1,300 pounds
Liquid (12% calcium, 11.9 lb calcium per gallon)	23 gallons

Table 3-3. Peanut Response to Soil pH and Gypsum Rate[a]

Approximate Soil pH	Peanut Yield Relative to Gypsum Rate		
	0	0.5×	1.0×
	Percent of Maximum Yield		
4.5	42 f	55 e	55 e
5.2	55 e	56 e	59 e
5.6	78 c	78 c	69 d
6.0	84 b	97 a	95 a

[a]Means followed by the same letter are not significantly different at p = 0.10. Data are pooled over three years.

A Single Rate Applied Across the Entire Field without Grid Sampling and Variable Rate Application

Applying the recommended rate in Table 3-10 regardless of soil calcium level is the least risky approach

Applying 70% of the recommended rate in Table 3-10, regardless of soil calcium level, can be as effective as the recommended rate in many fields with a lower cost and fewer logistical challenges

Possible Alternatives to Broadcast Applications of the Same Rate Across the Entire Field

Using the Relationship of Soil Calcium in Pounds Calcium per Acre to Target the Gypsum Rate

If 1000 pounds calcium per acre in soil or greater, apply 50% of recommended rate in Table 3-10. If 50% cannot be applied uniformly, increase the rate until you reach the lowest rate that can be applied uniformly.

If 700-1000 pounds calcium per acre in soil, apply 75% of recommended rate in Table 3-10.

If <700 pounds calcium per acre in soil, apply recommended rate in Table 3-10.

Figure caption: calcium deficient pods (top left), roots with nodules (center), stems showing zinc toxicity (bottom right)

Photo credits: David Jordan

Figure caption: area of field experiencing zinc toxicity

Zinc Recommendation

If pH is lower than 6.5, do not plant peanuts if Zinc Index exceeds 1,000

If pH is 6.0 to 6.5, do not plant peanuts if Zinc Index exceeds 500

If pH is less than 6.0, do not plant peanuts if Zinc Index exceeds 250

*Assumes pH uniformity across the field

Can the zinc index values be adjusted upwards within the same pH categories? Still working on this question.

Figure caption. Boron toxicity

Figure caption. Manganese deficiency

Figure caption. Expression of manganese deficiency in a peanut field

NCDA&CS Agronomic Division	Phone: (919) 664-1600	Website: www.ncagr.gov/Divisions/Agronomic-Services	Report No.	FY25-SL002350
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Sample ID: GRGOD	Recommendations: Crop	Lime (tons/acre)	N	P_2O_5	K_2O	Mg	S	Mn	Zn	Cu	B	More Information
Lime History:	1 - Peanut	0.0	0	0	50	0	0	0	Z	0	0.5	Note: 3 Note: $
	2 -	0.0										

Nutrients (lb/acre)

Test Results [units - W/V in g/cm^3; CEC and Na in meq/100 cm^3; NO_3-N in mg/dm^3]: Soil Class: Mineral

HM%	W/V	CEC	BS%	Ac	pH	P-I	K-I	Ca%	Mg%	S-I	Mn-I	Mn-AI1	Mn-AI2	Zn-I	Zn-AI	Cu-I	Na	ESP	SS-I	NO_3-N
0.36	1.31	5.4	81	1.0	5.9	176	37	67	10	31	120	82		325	325	338	0.0			

Sample ID: GRBAD	Recommendations: Crop	Lime (tons/acre)	N	P_2O_5	K_2O	Mg	S	Mn	Zn	Cu	B	More Information
Lime History:	1 - Peanut	0.0	0	0	40	0	0	pH$	0	0	0.5	Note: 3 Note: $
	2 -	0.0										

Nutrients (lb/acre)

Test Results [units - W/V in g/cm^3; CEC and Na in meq/100 cm^3; NO_3-N in mg/dm^3]: Soil Class: Mineral

HM%	W/V	CEC	BS%	Ac	pH	P-I	K-I	Ca%	Mg%	S-I	Mn-I	Mn-AI1	Mn-AI2	Zn-I	Zn-AI	Cu-I	Na	ESP	SS-I	NO_3-N
0.18	1.29	7.1	100	0.0	7.6	162	41	69	28	28	110	51		233	233	270	0.0			

Figure caption: soil test report showing a soil pH high enough to cause a manganese deficiency (this soil test report aligns with the previous image showing manganese deficient peanuts)

Table 3-9. Amount of Formulated Product Needed to Provide Equivalent Amounts of Elemental Boron per Acre

Source	Amount Needed to Supply 0.5 lb Boron per Acre
Boric acid	3.0 lb
Disodium octaborate (Solubor, 17.5% boron)	2.8 lb
Liquid (9.0% boron)	2.2 qt

Table 3-10. Amount of Formulated Manganese Products Needed to Provide Equivalent Amounts of Elemental Manganese per Acre

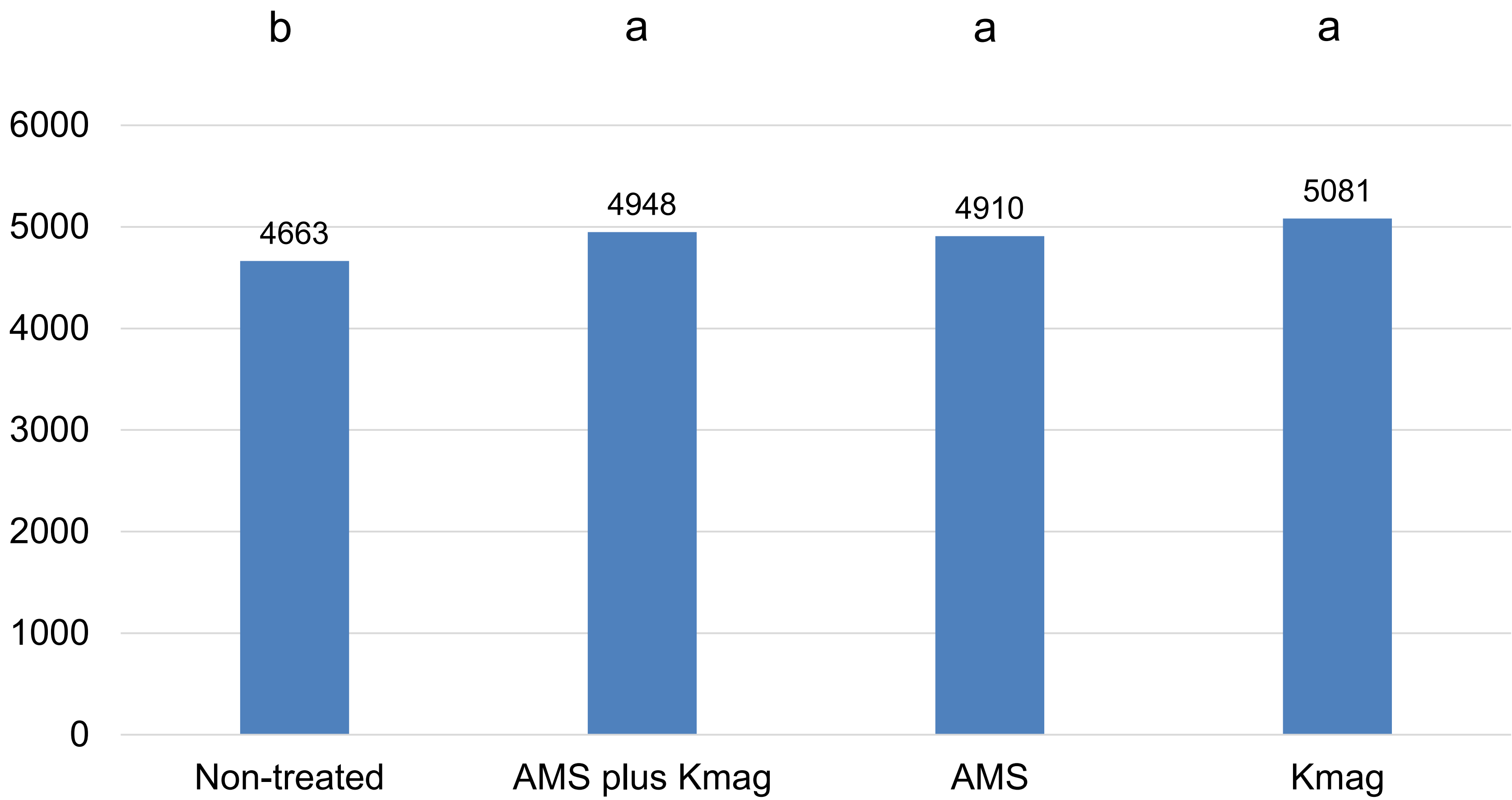
Source	Amount Needed to Supply 1.0 lb Manganese per Acre
Manganese sulfate (Techmangum, 27% manganese)	3.7 lb
Manganese sulfate (8% manganese)	1.2 gal

Figure caption: pale green color of peanuts in background and advanced decline of nutrition in peanut leaves (small image on right)

Peanut Yield (pounds per acre) from Large-Plot Trial

Johnston County – Blake Adams and Tim Britton

KI = 22-33 immediately prior to application on July 9



P = 0.0123, CV = 2.8%

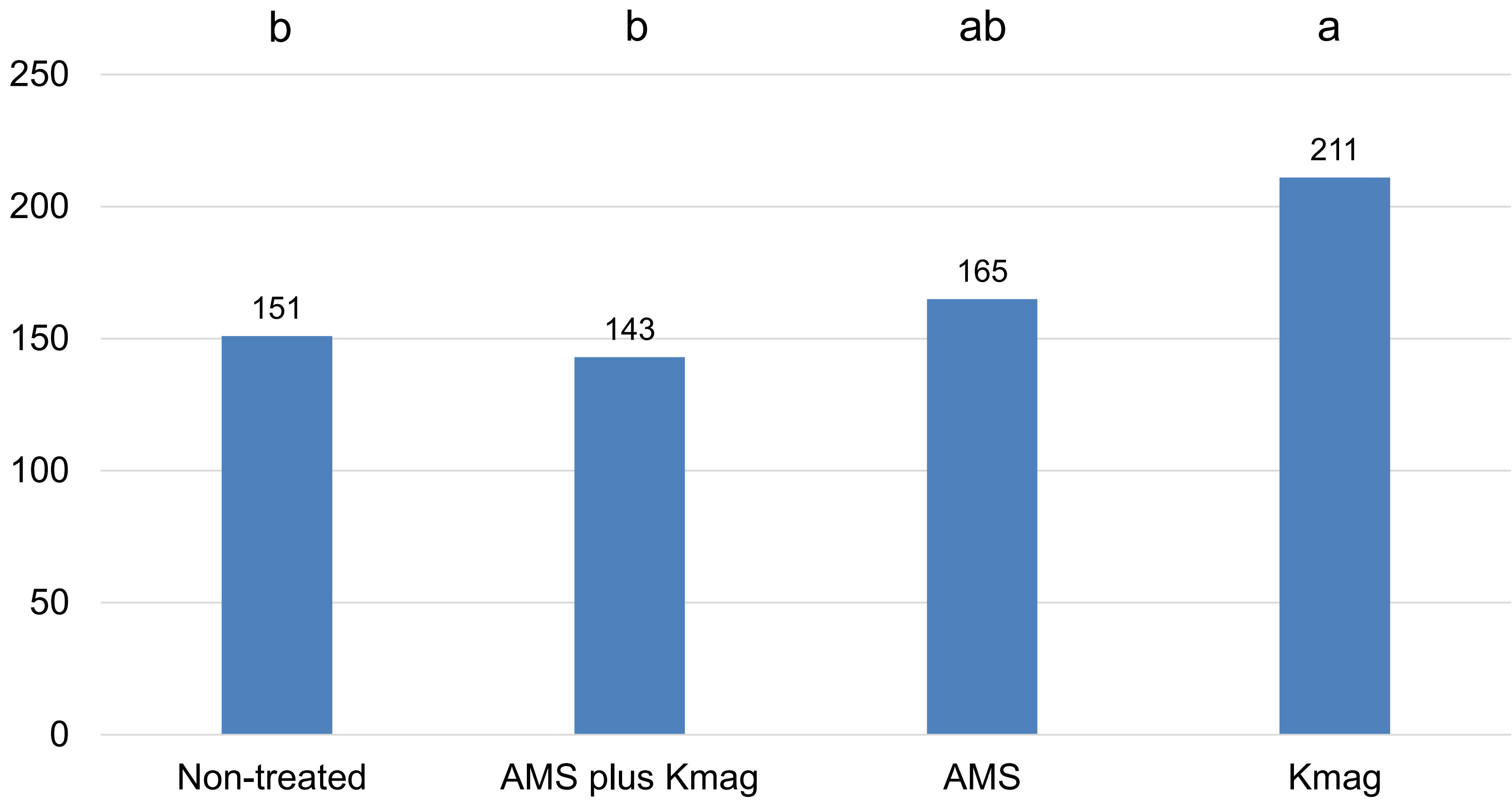
Net Return ($ per acre) from Large-Plot Trial

Johnston County – Blake Adams and Tim Britton

KI = 22-33 immediately prior to application on July 9

Net return = (yield × $0.2675) – (fertilizer cost + application cost + drying and hauling costs)

Ammonium sulfate ($35/acre), KMag ($30/acre), Application ($10/acre)



P = 0.0687, CV = 19.7%