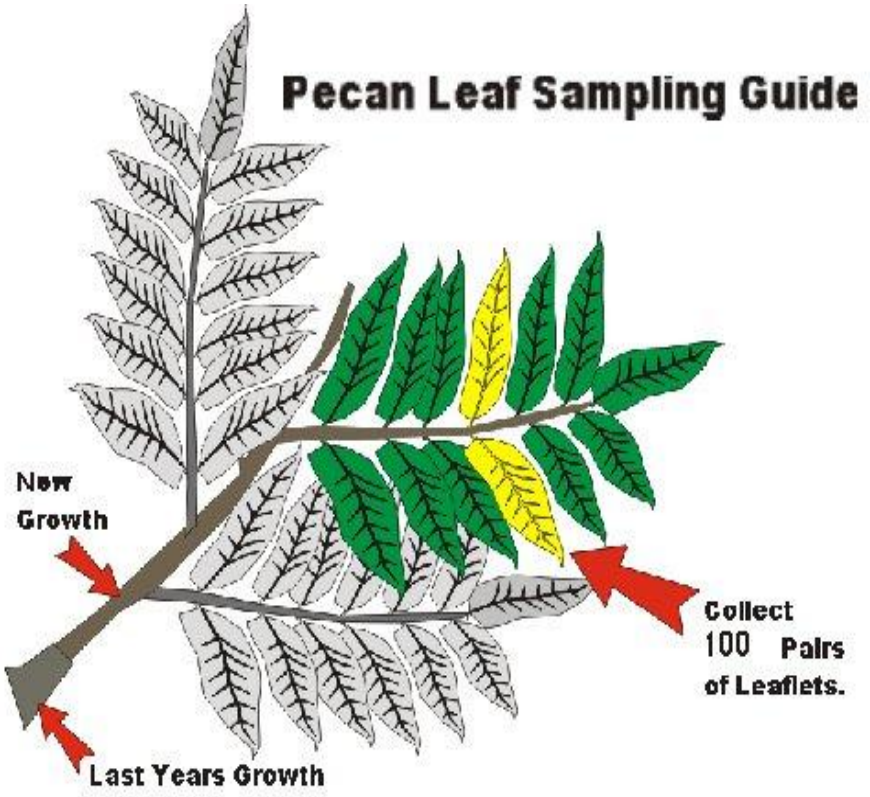
Nutritional Requirements & Fertilizer Management of Pecan

Lenny Wells

UGA Horticulture

Leaf Sampling

- Sample trees between July 7th and August 7th.
- Use terminal shoots exposed to the sun.
- Collect leaflets from all sides of the tree.
- Avoid leaflets damaged by insects and diseases.



Soil Sampling

- Useful for pH and toxicities
- Late Fall/Winter
- Sample uniform area
- 1 pint/sample (15-20 cores) over large area
- Sample to 8” depth

Nitrogen

- General Recommendation: 10 lbs N/100 lbs expected crop
    - Split April/June/August

- Most of the N taken up during the kernel-fill stage will supply the N storage pool needed for early spring growth.

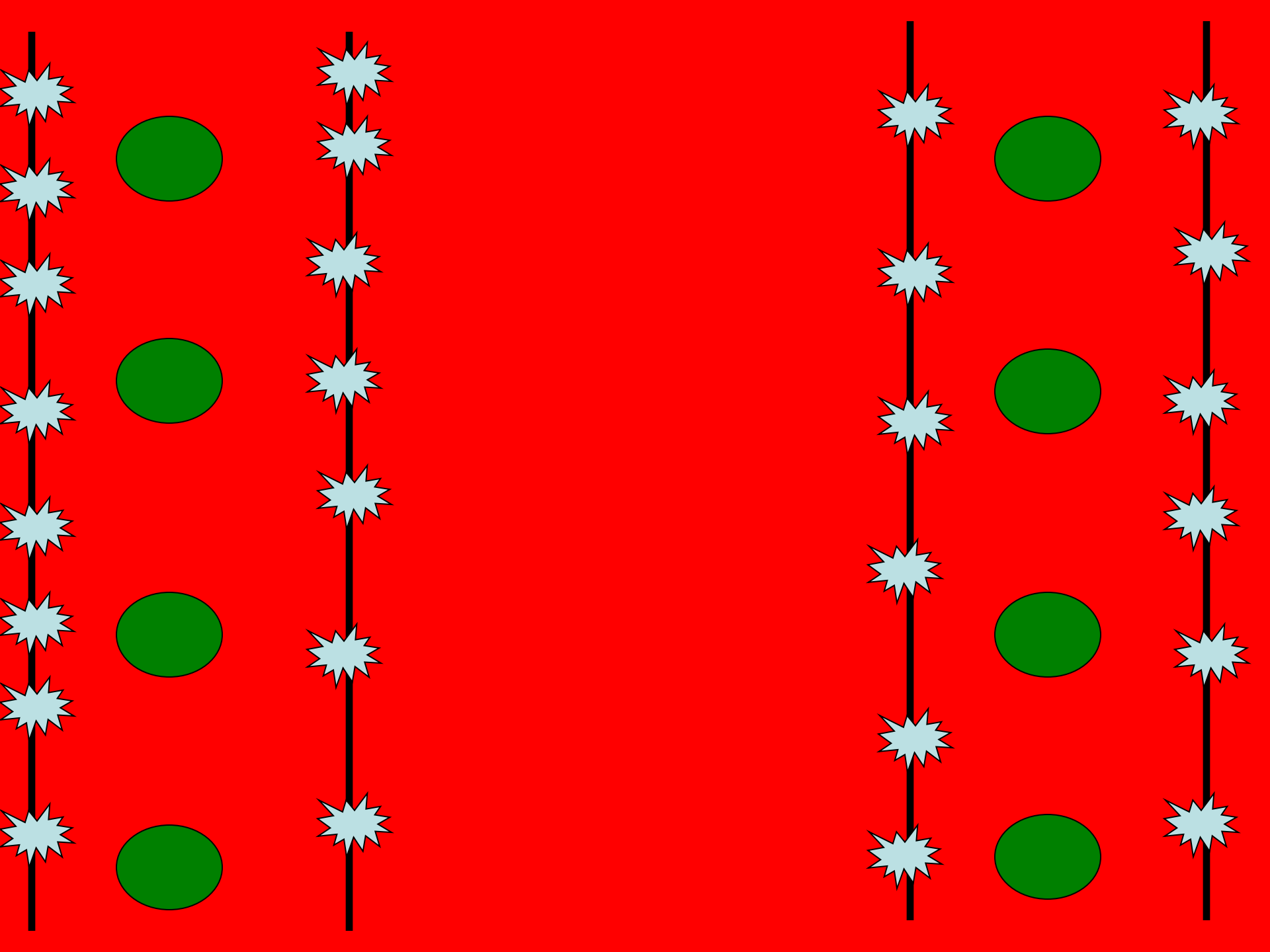
- Dry-Land /Neglected Orchards

    Split March/May

Nitrogen

Young trees

- **Year 1:** **1 lb 10-10-10in June if growth is good**
  (2-4' terminal growth)
- **Year 2:** **1 lb in April and 1 in June**
- **Year 3-4:** **2 lbs in April and June**
- **Year 5-7:** **4 lbs in April and June**



- 40 X 40
- 12 foot wide herbicide strip:
- 12/40 = 30%
- Can reduce area that you apply fertilizer to by 70% with band application

At a rate of 75 lbs per acre:
100 acres X 75 = 7500 lbs N
7500 X 30% = 2250 lbs N

- At $1/lb = a savings of $52.50 per acre with band application

Broadcast Band Application
24% of orchard floor

Liquid 28-0-0-5 applied over herbicide strip
30% of orchard floor

Injection Through Drip System

Broadcast Application
100% of orchard floor

Fertilizer Application Method
Effect on Leaf N

Treatment	Leaf N 2008	Leaf N 2009	Leaf N 2010 (lbs/tree)	Leaf N Average
Simulated Injection 28-0-0-5	2.98a	2.94a	2.73a	**2.88**
Broadcast Band Ammon. Nitrate	2.89ab	2.80a	2.52b	**2.74**
Broadcast Ammon. Nitrate	2.85b	2.89a	2.60b	**2.78**
Liquid N Herbicide Sprayer 28-0-0-5	2.80b	2.96a	2.42c	**2.73**

N rate for all treatments = 70 lbs/treated acre

Funded by GACCP

Fertilizer Application Method
Effect on Yield

Treatment	Yield 2008 (lbs/tree)	Yield 2009 (lbs/tree)	Yield 2010 (lbs/tree)	Yield Average (lbs/tree)
Simulated Injection 28-0-0-5	129.6a	128a	134a	**130.5**
Broadcast Band Ammon. Nitrate	107.8a	144a	98b	**116.6**
Broadcast Ammon. Nitrate	107.5a	176a	105ab	**129.5**
Liquid N Herbicide Sprayer 28-0-0-5	152.9a	115a	124ab	**130.6**

N rate for all treatments = 70 lbs/treated acre

Funded by GACCP

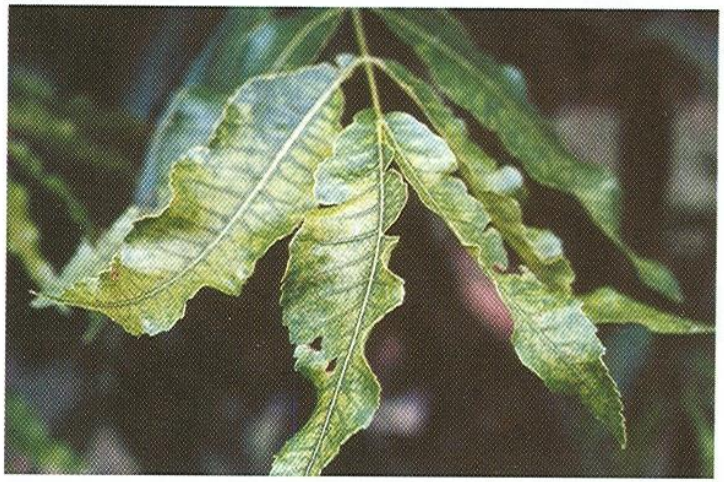
Summary

- Applying N to smaller percentage of the orchard floor reduces cost with no effect on production or leaf N through the 3rd year as compared to broadcast application of ammonium nitrate over 100% of the orchard floor
- Liquid 28-0-0-5 applied via drip may be the most efficient means of N fertilization

Potassium (K)

- K is transported to nuts at leaf's expense
- 50-100 lbs K applied in February/March
- During "on" year apply additional 30 lbs K in mid August
- 1.25-2.5 ppm in leaf analysis
- Manage N/K ratio to 2:1
- Manage Mg---(No Dolomitic lime above .45% Mg)
- Deficiency most common on Desirable and Schley

Zinc



45. Interveinal chlorosis and undulating margins of pecan leaflets with mild zinc deficiency. (Courtesy R. D. O'Barr)

- Necessary for shoot elongation, leaf expansion, and yield
- Apply when Zn in leaf is below 50 ppm
- 2 lbs Zinc sulphate + 3 lbs Potassium Nitrate/100 gallons
- Begin 2 wks after budbreak until shoot elongation complete

Mouse Ear

- Nickel Deficiency
- Zinc Management
- Nickel lignosulfonate

- **Apply 1 pt/A in spring (April) while canopy is developing (parachute stage);**
- **2nd application: 1 pt/A 30-60 days after 1st appl.**
- **Third application of 1.5-2 pts/A in late Sept.-early October before leaf fall to prevent mouse ear in the spring flush.**

Effect of Poultry Litter and Clover on 'Desirable' Pecan

Treatment	Leaf N (2008)	Leaf N (2009)	Leaf N (2010)	Leaf N (2011)	Leaf N (4 yr avg)
Poultry Litter	2.52a	2.63a	2.48a	2.67a	2.58
Crimson Clover	2.41a	2.67a	2.44a	2.54a	2.51
Litter + Clover	2.44a	2.96a	2.43a	2.59a	2.60
Ammonium Nitrate (75 lbs N/acre)	2.57a	2.66a	2.46a	2.67a	2.59
Untreated		2.67a	2.44a	2.47a	2.52

Effect of Poultry Litter and Clover on 'Desirable' Pecan

Treatment	Yield/tree (2008)	Yield/ tree (2009)	Yield/tree (2010)	Yield/tree (2011)	Yield/tree (4 yr avg)
Poultry Litter	92.7a	122ab	42a	85ab	85.4
Crimson Clover	94.7a	86ab	36a	57.5b	68.6
Litter + Clover	87a	84b	43a	105a	79.8
Ammonium Nitrate (75 lbs N/acre)	62a	129a	32a	92.6ab	78.9
Untreated	---	130a	17b	51.8b	66.2

Table 2. Total soil nitrogen (N), soil organic matter (SOM), and soil phosphorus (P) for clover, poultry litter, clover + poultry litter, ammonium nitrate, and control treatments from 2008–2010.

Yr	Treatment	N (%)	SOM (%)	P ($kg \cdot ha^{-1}$)
2008	Clover	0.10 a[z]	2.65 a	63 c
	Litter	0.10 a	2.75 a	249 a
	Clover + litter	0.10 a	2.70 a	152 b
	Ammonium nitrate	0.10 a	2.25 b	78 c
2009	Clover	0.12 a	2.44 a	49 b
	Litter	0.14 a	2.44 a	116 a
	Clover + litter	0.14 a	2.15 ab	132 a
	Ammonium nitrate	0.13 a	2.28 a	69 b
	Control	0.13 a	2.01 b	74 b
2010	Clover	0.14 a	1.93 a	63 b
	Litter	0.11 ab	1.78 ab	242 a
	Clover + litter	0.11 ab	2.10 a	202 a
	Ammonium nitrate	0.10 ab	1.74 ab	92 b
	Control	0.09 b	1.44 b	99 b

[z]Means followed by the same letter are not different at $P \leq 0.05$ by Duncan's multiple range test.

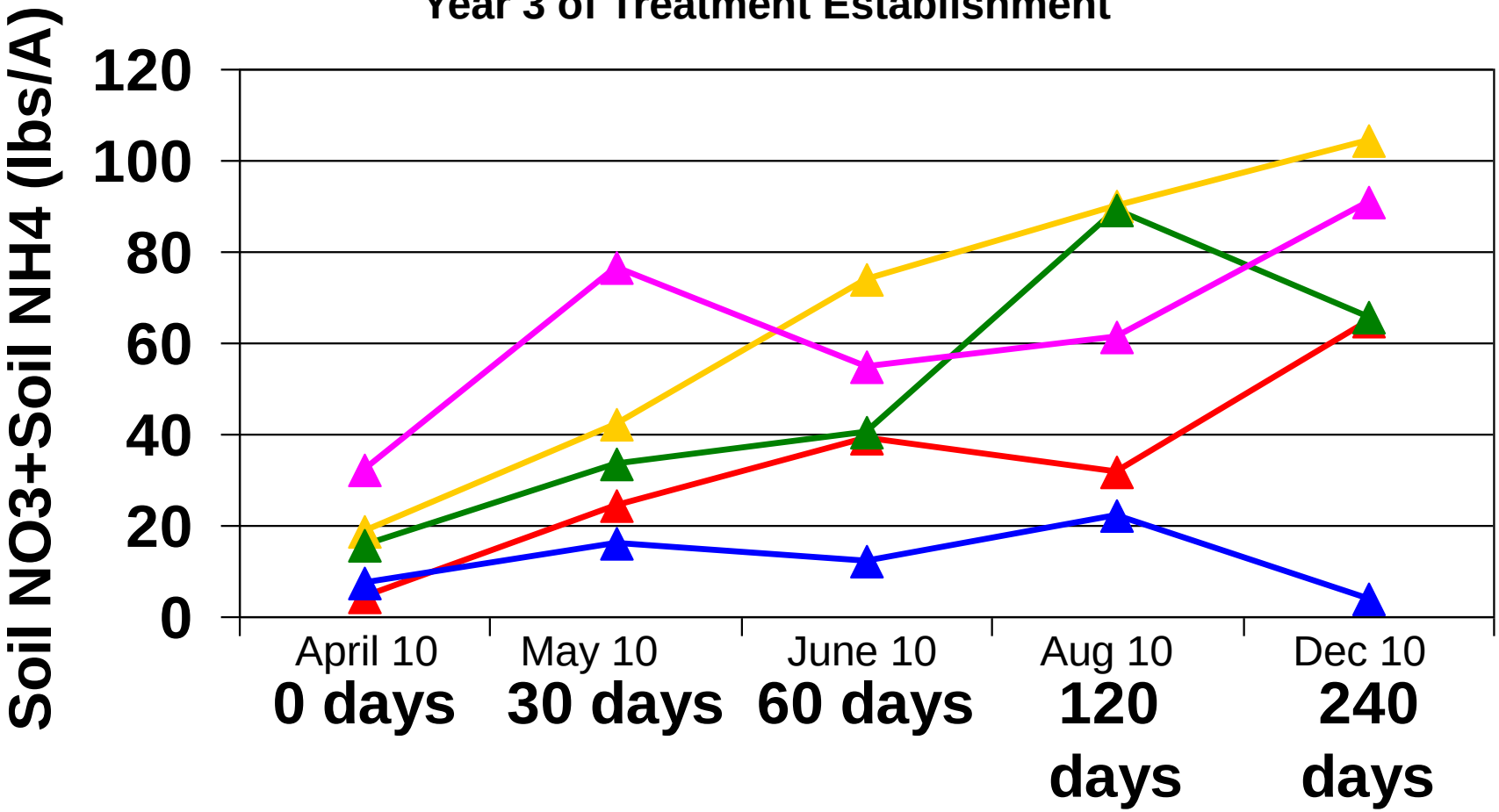
Table 3. Mycorrhizal inoculum potential (MIP), microbial biomass carbon (MBC), and phosphatase activity for clover, poultry litter, clover + poultry litter, ammonium nitrate, and control treatments.

Yr	Treatment	MIP (percent AM root colonization)	Microbial biomass carbon (Mg C/kg soil)	Phosphatase ($mMol \cdot g^{-2} \cdot h^{-1}$)
2008	Clover	46.7 a[z]	—	10.6 a
	Clover/litter	22.0 b	—	9.8 ab
	Litter	26.5 ab	—	7.5 b
	Ammonium nitrate	25.9 ab	—	7.4 b
2009	Clover	13.3 a	250 a	3.5 a
	Clover/litter	6.7 ab	220 a	3.2 ab
	Litter	3.0 b	240 a	2.8 bc
	Ammonium nitrate	4.3 b	180 b	2.9 abc
	Control	4.4 b	170 b	2.3 c
2010	Clover	4.0 a	140 a	9.6 a
	Clover/litter	0.0 b	120 b	8.6 a
	Litter	0.0 b	100 b	10.4 a
	Ammonium nitrate	0.0 b	120 b	10.5 a
	Control	0.0 b	120 b	13.3 a

[z]Means followed by the same letter are not different at $P \leq 0.05$ by Duncan's multiple range test.
AM = arbuscular mycorrhizal.

2010 Nitrogen Availability

Year 3 of Treatment Establishment



Summary

- Poultry Litter should be applied in March
- On very sandy soil, crimson clover contributes about 30 lbs additional N per acre early in the establishment phase
- Clover also enhances organic matter and biological activity of soil*
- Clover can provide adequate late season N, but fertilizer application is necessary in spring where clover is used
- Particularly in a wet year, additional late season fertilizer application may be necessary

Why is my leaf S always deficient?

- In the 2008 orchard survey, soil S of Georgia pecan orchards averaged 26.6 lb/a, which is within the desired range of 10-50 lbs/acre.
- C:S ratio
- Sulfur is generally immobilized in soils with a C:S ratio greater than 400:1, even when soil tests indicate an adequate S level.

	C:S ratio (1-6” depth)
Mean	504:1
Sample Range	95:1-1600:1

Sulfur and Nitrogen

- Uptake and assimilation of N and S by plants are strongly interrelated and dependent upon one another
- At high N levels, S deficiency symptoms become more pronounced
- Sulfur deficiency impairs nitrogen use efficiency
- Greenhouse studies have shown S deficiency symptoms occurred when pecan leaf S was less than 0.16% (Hu et al. 1991). *This study also showed that the leaf N:S ratio was a reliable indicator of tree S status.*
- A N:S ratio of 9:1 has been shown to be optimum for maximum growth of pecan (Hu and Sparks, 1992).

Foliar Sulfur Trial

	Leaf Nitrogen	Leaf Sulfur	Chlorophyll Index 7-11-11	N:S Ratio
Sulfur 1 qt/100 g	2.72a	0.20a	43.6a	13.6a
Urea 4 lbs/100g	2.58b	0.18b	42.0b	14.1a
Sulfur+Urea	2.70ab	0.19ab	42.3ab	14.0a
Untreated	2.73a	0.20a	41.4b	13.7a

Foliar Sulfur Trial

	Percent Kernel	Nut Weight	Count	N:S Ratio
Sulfur 1 qt/100 g	50.7a	9.7a	47.0b	13.6a
Urea 4 lbs/100g	50.2a	9.2b	49.2a	14.1a
Sulfur+Urea	50.2a	9.5ab	47.6b	14.0a
Untreated	50.6a	9.2b	49.2a	13.7a

Potential Added Value of Sulfur

- Sulfur has some level of disease suppression on many fungal plant pathogens
- SIR-Sulfur fertilization increased resistance against various fungal pathogens in many crops
- Sulfur effectively suppresses mite populations

Summary

- While foliar S did not increase leaf S or leaf N, foliar Urea sprays alone did reduce leaf S and leaf N
- Indicates that foliar S should probably be used where foliar Urea is used and/or where leaf N is maintained at a high level (>2.8%)
- Foliar S increased leaf chlorophyll index
- Foliar S increased nut weight and size