

INTRODUCTION

Forest fertilization in the southeastern U.S. has increased greatly since the 1960's. In 1998, about one million acres of loblolly pine plantations were fertilized with commercial fertilizers (NCSUFNC 1999), usually diammonium phosphate (DAP; 18-46-0), urea (46-0-0), or triple super phosphate (TSP; 0-46-0). Currently most pine plantation fertilization is on forest industry land.

Loblolly pine is considered to be the southern pine species which is most responsive to fertilization and other cultural practices. Slash, longleaf pine, and other southern pine stands are also fertilized but not to the extent that loblolly pine plantations are fertilized. Rates of return from fertilization typically average 8-12%, but can be as high as 25-30%

Three fertilization "windows" for pine plantations:

1. At planting or early post-planting to correct a nutrient deficiency (largely P limitations or specific micronutrients such as boron or copper),
2. At canopy closure, age 5-8 years-old (usually N+P), and
3. After a 1st or 2nd thinning in semi-mature stands (N, P, sometimes K, and micronutrients) or several years following thinning in semi-mature stands (N, P, sometimes K, and micronutrients).

BENEFITS of POULTRY LITTER APPLICATION to FOREST LAND

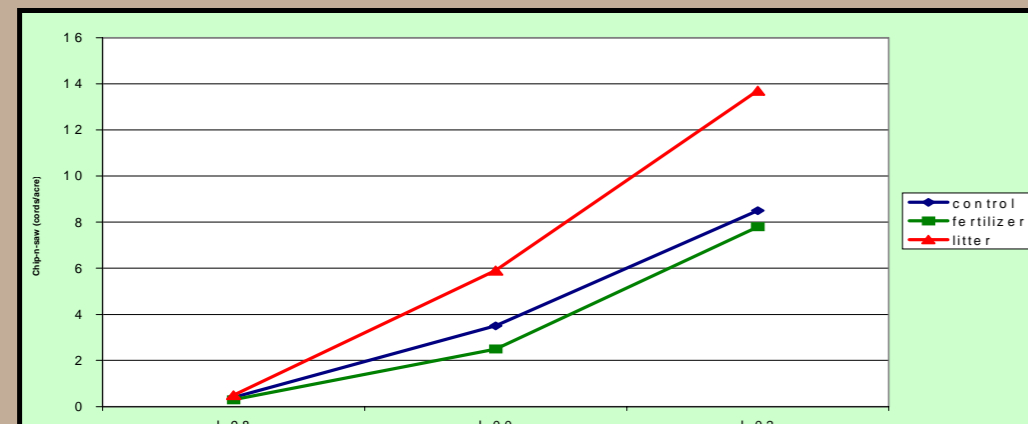


1. Supply Phosphorus (P) to forest soils that are generally low in plant available P.
2. Pine stand wood volume and straw production response to a single application of poultry litter can be significant and relatively long lived (four to ten years).
3. The addition of macro-nutrients other than N and P and micro-nutrients (especially Cu and Zn).
4. Add organic matter to the site (tons/acre).
5. Increase soil moisture holding capacity.

Poultry Litter Nutrient Requirements and Application Rates for Forest Fertilization

Litter Nutrient Content (lb/ton)	Newly Planted Pines				Mid-Rotation				Pine Straw Raking			
	Nutrient requirement (lb/acre)	Litter Application rate (ton/acre)	Nutrient requirement (lb/acre)	Litter application rate (ton/acre)	Nutrient requirement (lb/acre)	Litter application rate (ton/acre)	Nutrient requirement (lb/acre)	Litter application rate (ton/acre)	Nutrient requirement (lb/acre)	Litter application rate (ton/acre)	Nutrient requirement (lb/acre)	Litter application rate (ton/acre)
		Raw	Pelleted		Raw	Pelleted		Raw	Pelleted		Raw	Pelleted
N	54	<50	1-2	1	150-200	4	3	175-200	4	2-3		
P	28	20-50	1-2	1	25	1	1	50	2	2		
K	37.5	—	—	—	—	—	—	50	1-2	102		
		SLASH AND LOBLOLLY				LONGLEAF PINE						
N	54	Not Rec.	Not Rec.	Not Rec.	50-75	1	1	75-125	2	2		
P	28	25-50	1-2	1	25-50	1	1	25-50	1	1		
K	37.5	—	—	—	50-100	2	1	50-100	2	2		

Pelleted = screened litter run through pelletizing process producing higher nutrient density and uniform product.
Not Rec. = not recommended.



Chip and saw (dbh > 8.5") volume production 2 and 4 years after the first thinning (November 1997) by treatment (applied April/June 1998) in an old-field loblolly pine stand (Norfolk soil) in Clarendon County, S.C.

Poultry Litter Application Recommendations for Pine Plantations

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Study Areas and Experimental Design

Two Study areas:
 Flatwoods...Brantley county, GA.
 Coastal Plain...Mitchell County, GA
 Piedmont...Pine bark beetles destroyed plots

Experimental design:
 Randomized complete block design
 4 Treatments
 Control
 1 time litter application
 Annual litter application
 1 time commercial fertilizer
 Flatwoods: 250lbs DAP + 335lbs urea
 Coastal Plain: 250lbs DAP + 465lbs NH₄NO₃

Monitoring Wells

Six Total
 Well in lower 1/3 of plots for each treatment (4 total)
 One well up-gradient of study area
 One well down-gradient of study area

Well Depth
 Flatwoods...Deep as possible without collapse 11-16 ft
 About 5 ft saturated
 Coastal Plain... first restrictive layer 13-16 ft.
 Some not saturated

Lysimeter Sampling

Lysimeters were installed at:
 A depth of 1 meter

Two lysimeters per plot
 Water samples were composited by plot



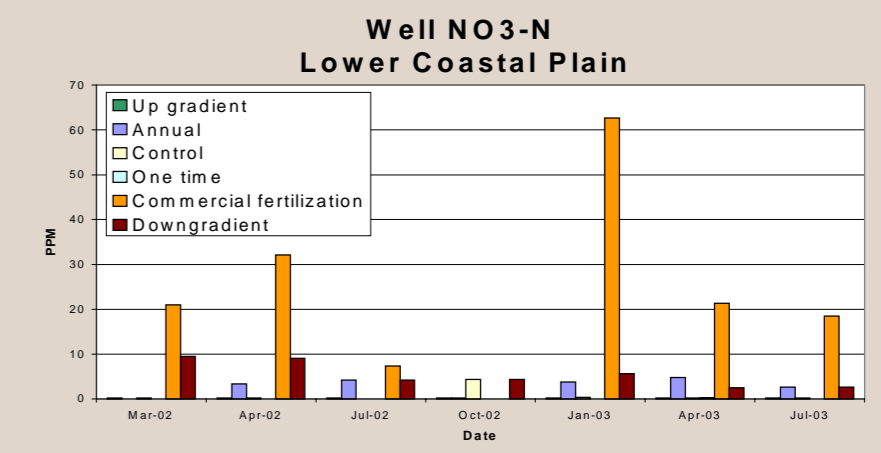
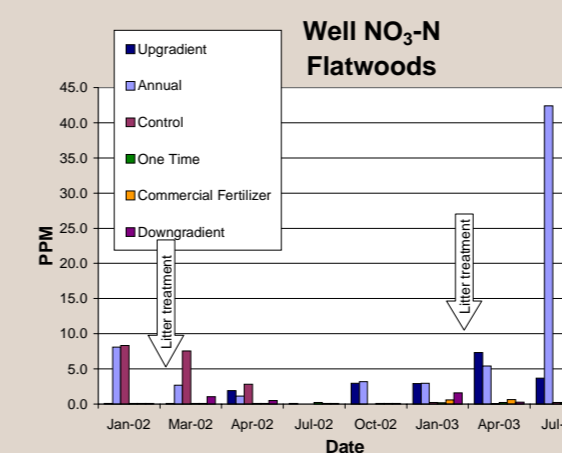
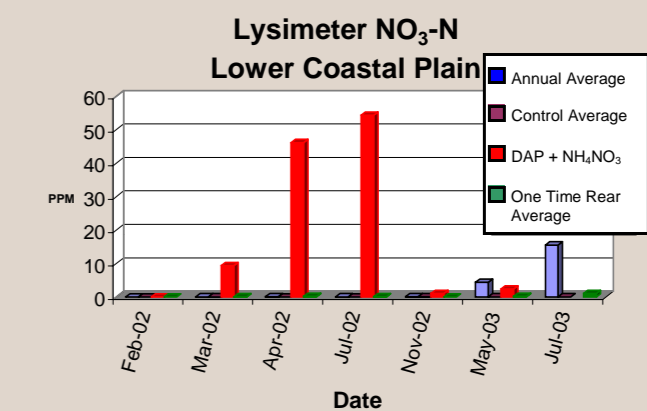
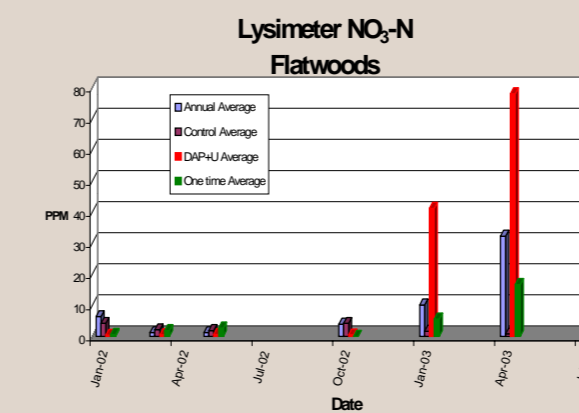
Impact of Poultry Litter Application in Pine Plantations on Near Surface Water Quality

Study Objectives

Determine the impact of applying poultry manure and litter in Southern Pine plantations on shallow groundwater

- *E. coli*
- Nitrate-N

Water Quality Results



E. coli

	Flatwoods	Coastal Plain
	Layer Manure	Broiler Litter
<i>E. coli</i> (MPN/g)	>24192	12
Jan-Feb 02	<1	No Water
Mar 02	<1	<1
Apr-May 02	<1	<1 to 2.3 (control well)
Jul-Aug 02	<1	No water
Oct 02	<1	<1
Jan 03	<1	<1
Apr 03	<1 to 1 (one time plot)	<1
Jul 03	<1	<1 to 30 (down gradient well)

Conclusions

- Annual litter application (4.6 t/ac) resulted in elevated groundwater Nitrate-N levels toward end of second year groundwater recharge period (December-May).
- Poultry manure (7.4 t/ac) and litter (4.6 t/ac) did not produce elevated groundwater *E. Coli* levels.
- DAP + Urea in Flatwoods... no problem
- DAP+ NH₄NO₃ in coastal plain... nitrate leaching.

Limitations of Poultry Litter Application to Forest Land

1. Access, turning radius, stump height, and rutting depth.
2. Excessive slope (>8 to 12 percent).
3. Application levels to achieve nitrogen per acre goals are typically in tons/acre.
4. Hauling distance.
5. Labor and time constraints.
6. Spreader availability.



See website for further details:
<http://www.bugwood.org/fertilization/PLARPP.html>

Summary and Conclusions

- When properly applied to pine plantations, poultry litter applications can increase tree growth, pine straw production, and revenue while cutting production costs and benefiting the environment. The principal limitation to litter application in pine stands is access. Other limiting factors include hauling distance and number of acres applied/day.
- Poultry litter application rate/level determination depends on pine species, age, stocking, current site fertility, poultry litter characteristics, frequency of application, and soil test-P levels.
- Good weed control is required when poultry litter is applied pre- or early post-planting.
- In young longleaf pine stands (mean d.b.h. <6") poultry litter application level should not exceed 75 lbs PAN/acre.
- Application of poultry litter (either stacked broiler or fresh layer) at silvicultural recommendation manure rates did not produce detectable *E. coli* in shallow groundwater or nitrate-N levels above 10 ppm nitrate-N US-EPA drinking water standards. Commercial fertilizer applied as DAP and ammonium nitrate did produce shallow groundwater levels in excess of 10 ppm nitrate-N early post application. Application of urea and DAP did not increase nitrate-N above EPA drinking water standards to date.