#128
2001/2002
FINAL
56,136,138

NATIONAL PEANUT BOARD/SOUTHEAST PEANUT RESEARCH INITIATIVE
FINAL REPORT FOR WORK
January 30, 2004

see summary - last page

DONE UNDER RESEARCH AGREEMENT: 25-21-RF328-615

INSTITUTION: University of Georgia

PROJECT TITLE: Effect of High Poultry Litter Rates on and Residual Effects on Following Crops and Soil Quality.

RES. AGR. NO.: 25-21-RF328-615, PROJECT LEADER: Gary Gascho

EXPIRATION DATE: December 31, 2003

SPRI CONTACT: Emory Murphy. NPB CONTACT: Stephen O'Brien

REPORT:
With the increase in poultry in the peanut belt, the waste "litter" will be applied either directly or to the rotational crops of peanut. The objective of the research presented was to determine if high rates of litter will affect yield grade and value of the peanut crop.

Procedures
Experiments in support of this project were conducted at the Lang Farm at Tifton, GA from 2000 through 2002, Headland, AL in 2001 and 2002, Quincy FL in 2001 and 2002, Attapulgus, GA 2002 and 2003 and at the Ponder Farm at Tifton, GA 2002 and 2003.

The work at the Lang Farm involved a three year double-cropped rotation where 4 rates of broiler litter were applied prior to strip-tillage for each crop from 1996 through 1999 (main plots) and thereafter none was applied for peanut, but rates of 0, 1, and 2 ton/acre were applied to the subplots. The main plot results are then the effects of the long-term residual effects of broiler litter application. Data were also collected in 2002 to indicate the short term-term effects on peanut from the applications to other crops in the subplots. Peanut followed cotton in all years.

The experiments at Attapulgus, Headland, and the Ponder Farm at Tifton had tillage main plots and broiler litter rate subplots. The interactions between tillage and broiler litter rates will be provided in another report. In this report the effects of tillage are averaged for each broiler litter rate. The experiments at Quincy, Fl had litter application rates of 0 and 6 ton/acre. The 6 ton/acre was applied either 0, 1, 2, or 3 weeks prior to planting peanut.

Results
Yield, grade and value/acre data are provided in Table 1 for the experiment at the Lang Farm in Tifton. Yield was decreased in 2000 by the long-term highest rate of 6 ton/acre/crop. However, by 2001 and for 2002, the negative effect of broiler litter on yield had diminished., but yield continued to be numerically greatest where no broiler litter was applied from 1996-1999. No

significant differences were recorded due to residual broiler litter applications for either TSMK or value of the peanuts/acre. The incidences of rhizoctonia were recorded in 2000 and 2001 (Table 2) indicating that the residual litter rate increased rhizoctonia greatly in the first year and modestly in 2001.

Table 1. Effects of long-term residual broiler litter rates on peanut yield, grade, and value at the Lang Farm, Tifton, 2000-2002.

Litter rate†	2000	2001	2002	Mean
ton/acre	----------lb pods/acre----------			
0	5144 a*	4764 a	2062 a	3990 a
2	5228 a	4583 a	1882 a	3898 a
4	5316 a	4746 a	1631 a	3898 a
6	5062 a	4420 a	1587 a	3690 a

Litter rate†	2000	2001	2002	Mean
ton/acre	---------- % TSMK ----------			
0	73 a	74 b	72 a	73 a
2	73 a	76 a	73 a	74 a
4	73 a	76 a	73 a	74 a
6	72 b	77 a	72 a	74 a

Litter rate†	2000	2001	2002‡	Mean
ton/acre	----------Value ($)/acre----------			
0	1628 a	1533 a	511 a	1224 a
2	1664 a	1799 a	467 a	1310 a
4	1685 a	1557 a	404 a	1215 a
6	1580 a	1464 a	391 a	1145 a

† Rates applied to all crops in the rotation twice/year from 1996-1999.

‡ Includes grade and additional payments to the grower in the revised payment schedule that began in 2002.

* Values in a group and column followed by a common letter are not different by LSD (p = 0.05).

Table 2. Effects of long-term broiler litter applications on the incidences of rhizoctonia in 2000 and 2001 at the Lang Farm, Tifton.

Litter rate†	2000	2001
ton/acre	----------no plants/plot----------	
0	17 c*	8 b
2	35 b	nd‡
4	42 a	nd
6	40 a	11 a

† Rates applied to all crops in the rotation twice/year from 1996-1999.

‡ nd = no data

*Values in a group and column followed by a common letter are not different by LSD (p = 0.05).

The short-term effects of broiler litter application to cotton in 2001 were measured in peanut in 2002 in the subplots (Table 3). Both pod yield and value/acre of peanut were decreased by application of 2 ton/acre broiler litter in the previous cotton crop. TSMK was unaffected.

Soil tests in 2002 (0-6 inch depth) indicated some great changes in available soil nutrients (Table 4). Increases in soil test P, Cu, and Zn were very large with increasing broiler litter rates. Long-term application of broiler litter at high rates will lead to excessive rates of these three immobile elements in the top soil. Soil pH, NO3_N and NH4_N were not affected by the residual broiler litter rates. The modest increase in soil C indicates that it is possible to increase soil organic matter modestly by application of organic materials at high rates.

Short-term effects of lesser rates show similar trends for soil tests, but more modest changes than the effects of the residual rates (Table 5).

Over the total period of the experiments with broiler litter on peanut at the Lang Farm (1996-2001), yield and value/acre of peanut remained the greatest when no broiler litter was applied. Surface application, prior to strip-tillage either had no effect or decreased yield and value. Much of the negative effect may be due to increased disease incidence, particularly Rhizoctonia where high rates of broiler litter were applied.

Table 3. Effects of broiler litter applied before cotton in 2001 on peanut yield, grade, and value at the Lang Farm, Tifton in 2002.

Litter rate†	Pod yield	TSMK	Value‡
ton/acre	lb/acre	%	$/acre
0	1936 a*	73 a	480 a
1	1890 a	72 a	466 a
2	1546 b	73 a	384 b

† Rates applied to the cotton in 2001.
‡ Includes grade and additional payments to the grower in the revised payment schedule that began in 2002.
* Values in a group and column followed by a common letter are not different by LSD (p = 0.05).

Table 4. Soil tests following peanut in 2002 as affected by residual broiler litter rates, applied at the Lang Farm, Tifton, 1996-1999.

Litter rate	pH	P	K	Ca	Mg	C
ton/acre		mg/kg				%
0	6.62 a*	4 d	34 b	459 c	41 b	0.59 b
2	6.60 a	83 c	44 b	607 b	50 a	0.66 ab
4	6.55 a	117 b	48 ab	703 ab	53 a	0.72 a
6	6.54 a	143 a	61 a	741 a	54 a	0.73 a

Litter rate	Cu	Zn	Mn	NO3-N	NH4-N
ton/acre	mg/kg				
0	0.46 d	2.58 d	7.59 c	1.11 a	2.13 a
2	0.88 c	4.79 c	9.09 b	2.00 a	2.42 a
4	1.13 b	6.86 b	9.90 ab	2.62 a	2.16 a
6	1.62 a	9.53 a	10.86 a	2.90 a	2.28 a

* Values in a group and column followed by a common letter are not different by LSD (p = 0.05).

Table 5. Soil test following 2002 peanut at the Lang Farm, Tifton as affected by the broiler litter applied prior to the preceding crop of cotton.

Litter rate	pH	P	K	Ca	Mg	C
ton/acre		mg/kg				%
0	6.69 a*	83 b	39 b	617 a	46 a	0.63 b
1	6.53 b	102 a	48 ab	645 a	51 a	0.71 a
2	6.52 b	107 a	53 a	620 a	52 a	0.68 ab

Litter rate	Cu	Zn	Mn	NO3-N	NH4-N
ton/acre	mg/kg				
0	0.96 a	5.31 b	9.02 a	1.57 a	2.15 a
1	1.06 a	5.89 ab	9.85 a	2.64 a	2.37 a
2	1.05 a	6.63 a	9.17 a	2.22 a	2.21 a

* Values in a group and column followed by a common letter are not different by LSD (p = 0.05).

Yield was increased by any application of poultry litter at the headland site in 2001(Table 6). TSMK was unaffected and neither yield nor TSMK was affected in 2002. This was the only experiment in the 11 presented that indicates any increased production due to litter application. The soil test data in Table 7, from samples taken following harvest do not support that the increase could be due to increased nutrition as pH, P, K, Ca, and Mg values where no litter was applied were adequate for peanut (see soil tests in 2002, where there was no response, Table 8). The low yield for the no litter applied plots at Headland in 2001 can not be explained from the data.

Table 6. Effect of poultry litter rates on peanut yield and grade at Headland, 2001-2002.

Litter rate	2001		2002	
ton/acre	yield (lb/acre)	TSMK (%)	yield (lb/acre)	TSMK (%)
0	3180 b*	68 a	3962 a	74 a
2	4152 a	68 a	4132 a	74 a
4	4527 a	66 a	4043 a	75 a
6	4670 a	68 a	3812 a	74 a

* Values in a group and column followed by a common letter are not different by LSD (p = 0.05).

Table 7. Effect of poultry litter rates on soil tests at peanut harvest, Headland, 2001.

Litter rate	pH	P	K	Ca	Mg
ton/ac		mg/kg			
0	6.5 a*	55 b	44 c	476 a	55 a
2	6.5 a	70 ab	62 bc	472 a	57 a
4	6.5 a	67 ab	72 ab	492 a	60 a
6	6.5 a	85 a	83 a	505 a	58 a

* Values in a group and column followed by a common letter are not different by LSD (p = 0.05).

In a similar manner to the earlier data from the Lang Farm, soil pH was not changed due to litter, but nutrient soil tests increased with rate, especially P, Cu, and Zn (Table 8).

Table 8. Effect of poultry litter rates on soil tests at peanut harvest, Headland, 2002.

Litter rate	pH	P	K	Ca	Mg	Cu	Fe	Mn	Zn
ton/ac		mg/kg							
0	6.4 a*	47 b	44 b	449 b	48 a	2.4 b	17 a	42 b	4.5 b
2	6.4 a	77 a	67 a	548 a	55 a	3.4 a	18 a	48 ab	6.3 ab
4	6.4 a	76 a	69 a	522 a	56 a	3.2 ab	17 a	48 ab	5.9 ab
6	6.4 a	80 a	71 a	551 a	55 a	3.9 a	19 a	49 a	7.4 a

* Values in a group and column followed by a common letter are not different by LSD (p = 0.05).

At Quincy in 2001, yield was not affected by litter application, regardless if it was applied up to 3 weeks prior to planting (Table 9). TSMK was greatest where no litter was applied. In 2002, any application of litter resulted in lower yield than where none was applied. TSMK was unaffected by litter or its timing of application. Seed concentrations of Ca, K, and Mg appeared to be adequate for good germination, however Ca concentrations were increased by litter applications.

Table 9. Effect of poultry litter rates on peanut yield and grade at Quincy, 2001-2002.

Litter timing	2001		2002	
weeks before planting	yield (lb/acre)	TSMK (%)	yield (lb/acre)	TSMK (%)
0	2305 a*	69 ab	847 b	66 a
1	2390 a	69 ab	946 b	68 a
2	2412 a	68 b	882 b	68 a
3	2461 a	70 ab	869 b	66 a
no litter	2273 a	71 a	1557 a	69 a

* Values in a group and column followed by a common letter are not different by LSD (p = 0.05).

Table 10. Effects of litter applications on seed nutrient concentrations, Quincy, 2001.

Litter timing	Ca	K	Mg
weeks before planting	----------mg/kg----------		
0	652 ab*	6481 a	1932 a
1	647 abc	6463 a	1938 a
2	680 a	6300 a	1948 a
3	596 bc	6460 a	1923 a
no litter	572 c	6414 a	1945 a

*Values in a group and column followed by a common letter are not different by LSD (p = 0.05).

Litter application made no significant changes in yield or grade of peanuts at Attapulgus in 2002 or 2003 (Table 11). Soil pH was not changed either year due to litter application (Table 12 and 13), soil P test increased with litter application in 2002, but not in 2003, K increased both years and Ca and Mg were unaffected. The Ca concentrations were near the critical levels in 2002.

Table 11. Effects of broiler litter rates on yield and grade of peanut, Attapulgus, 2002 and 2003.

Litter rate	2002		2003	
ton/acre	yield	TSMK	yield	TSMK
	lb/acre	%	lb/acre	%
0	2856 a*	70 ab	4165 a	72 a
2	2715 a	72 a	4018 a	72 a
4	2671 a	69 b	4366 a	72 a

* Values in a group and column followed by a common letter are not different by LSD (p = 0.05).

Table 12. Effects of broiler litter applications on soil tests, Attapulgus, 2002.

Litter rate	pH	P	K	Ca	Mg
ton/acre		----------mg/kg----------			
0	6.0 a*	33 c	40 c	248 a	21 a
2	6.0 a	39 b	47 b	247 a	25 a
4	6.0 a	47 a	53 a	266 a	28 a

* Values in a group and column followed by a common letter are not different by LSD (p = 0.05).

Table 13. Effect of broiler litter rates on soil tests, Attapulgus, 2003.

Litter rate	pH	P	K	Ca	Mg
ton/acre		----------mg/kg----------			
0	6.3 a*	41 a	53 b	303 a	57 a
2	6.4 a	42 a	56 b	335 a	70 a
4	6.3 a	44 a	63 a	330 a	64 a

* Values in a group and column followed by a common letter are not different by LSD (p = 0.05).

Yield and grade of peanut was not affected by broiler litter applications of up to 4 ton/acre at the Ponder Farm, Tifton, GA in either 2002 or 2003 (Table 14). Soil tests were not significantly affected by the litter applications either year and they appear adequate, with Ca concentrations close to the critical level of 250 mg/kg in Georgia (Tables 15 and 16).

Table 14. Effects of broiler litter rates on yield and grade of peanut at Bowen Farm, Tifton, 2002 and 2003.

Litter rate	2002		2003	
	yield	TSMK	yield	TSMK
ton/acre	lb/acre	%	lb/acre	%
0	1900 a*	66 a	4357 a	70 a
2	1652 a	64 a	4425 a	70 a
4	1806 a	65 a	4335 a	70 a

* Values in a group and column followed by a common letter are not different by LSD (p = 0.05).

Table 15. Effects of broiler litter applications on soil tests, Bowen Farm, Tifton, 2002.

Litter rate	pH	P	K	Ca	Mg
ton/acre		----------mg/kg----------			
0	6.04 a*	51 a	76 a	254 a	25 a
2	6.02 a	53 a	80 a	257 a	26 a
4	5.98 a	48 a	74 a	234 a	25 a

* Values in a group and column followed by a common letter are not different by LSD (p = 0.05).

Table 16. Effect of broiler litter rates on soil tests, Bowen Farm Tifton, 2003.

Litter rate	pH	P	K	Ca	Mg
ton/acre		----------mg/kg----------			
0	5.7 a*	23 a	47 a	283 a	18 a
2	5.8 a	26 a	48 a	282 a	18 a
4	5.7 a	25 a	53 a	279 a	19 a

* Values in a group and column followed by a common letter are not different by LSD (p = 0.05).

Summary

Eleven experiments were conducted from 2000 to 2003 to determine how high rates of poultry litter affect peanut yield and grade. Three experiments conducted at the Lang Farm in Tifton included effects from the long-term applications of litter in a strip-tilled rotation. The two experiments at Quincy FL involved treatments where the litter was applied either 3, 2, 1, or 0 weeks prior to planting. The remaining experiments included rates of litter applied prior to planting with a variety of tillages (see project involving tillage effects on the use of poultry litter). In eight cases neither yield or grade was affected by litter applications. Yield decreased with litter application in 2 cases and increased in one case. Grade (TSMK) increased in two cases and decreased in one case when litter was applied. Timing of the litter application relative to planting did not affect yield or grade. It is concluded that, over a variety of tillage methods, that poultry litter generally does no affect yield or grade of peanut. Since peanut is low fertility crop that normally does not respond to direct fertilization, the results of these studies are not surprising. Considering the outstanding responses of cotton and other crops to litter, it seems prudent to use the litter on the rotational crops and not apply it before planting peanut. Soil analyses indicate that litter applications at high rates do not have much effect on soil pH, However soil test nutrient values generally increase. Increases in the immobile elements P, Cu, and Zn are particularly great and they may signal longer-term environmental problems. For peanut, a build up of Zn can be detrimental as peanut is especially sensitive to Zn toxicity.