Does Fertilizing Soybean with Poultry Litter Enrich the Grain with Mineral Nutrients?

Rishi Prasad[1,2], Rajveer Singh[2], Tyler Sandlin[1] and Eddie McGriff[1]

1,2 rzp0050@auburn.edu 2 rzs0100@auburn.edu tns0012@auburn.edu 1. dem0029@auburn.edu

[1]Alabama Cooperative Extension System, [2]Department of Crop, Soil, and Environmental Sciences (CSES), Auburn University

INTRODUCTION

- **Ninety-eight percent** of U.S. soy meal is consumed as animal feed.
- Alabama ranks **second** in broiler production nationwide generating **1.5 million tons of poultry litter (PL) each year**.
- Many row crop farmers find PL as an alternate source for providing plant nutrients.
- However, little is known about the effect of PL on soybean grain yield and nutrient composition.

Table 1. Nutrients Typically Present in Broiler Litter

Primary Plant Nutrients	Secondary Plant Nutrients	Micronutrients
Nitrogen (N)	Calcium (Ca)	Copper (Cu)
Phosphorus (P_2O_5)	Magnesium (Mg)	Iron (Fe)
Potassium (K_2O)	Sulfur (S)	Manganese (Mn)
		Zinc (Zn)
		Boron (B)

OBJECTIVES

- Evaluate effect of PL on soybean grain yield.
- Investigate whether poultry litter enriches the soybean grain with mineral nutrients.

MATERIALS AND METHODS

- A field-plot study was conducted in **2018** and **2019** at **E.V. Smith Research Center** in Shorter, AL (32° 25′N, 85° 53′S) on a Compass loamy sand (coarse-loamy, siliceous, sub active, thermic Plinthic Paleudults).
- Experimental design was randomized complete block design (RCBD) with 4 replications.
- Treatments included pre-plant PL application at three rates (2.2, 5.6, and 11.2 Mg ha^{-1}) and a control.
- Plot yields were determined by combine harvesting the middle two rows and reported at *13 percent moisture* and *60 pounds per bushel*.
- Grain nutrient determination:
  - **Total N**: Combustion method using Leco analyzer.
  - **P, K, Mg, Ca, S, B, Zn, Mn, Fe and Cu**: Acid digestion followed by ICP analysis.
- Data analyses were performed using PROC GLIMMIX of SAS 9.4.

Table 1: Various management practices adopted in the study.

Management	E.V. Smith	
Cultivar:	AG74X8	
Maturity Group:	7	
Planting Date:	12 July 2018	14 June 2019
Row Spacing:	36 inch	
Harvest Date:	29 Nov. 2018	20 Nov. 2019

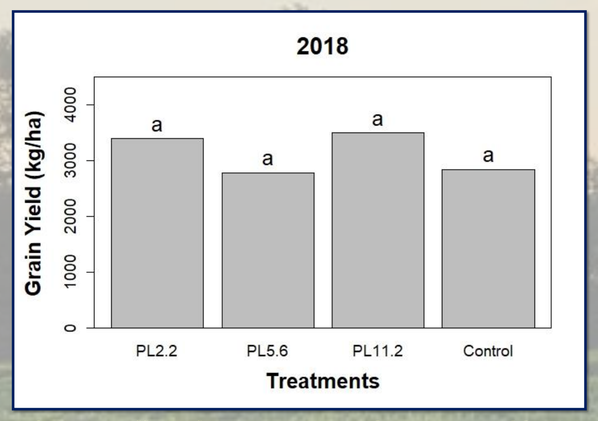
Table 2: Chemical properties of poultry litter applied each year at the study site.

Year	Moisture	C	N	P	K	Mg	Ca	B	Zn	Mn	Fe	Cu
						g kg^{-1}						
2018	262	351	27	20	20	6	12	0.03	0.17	0.23	1.50	0.06
2019	378	262	36	29	34	5	22	0.03	0.3	0.5	0.6	0.4





RESULTS AND DISCUSSION



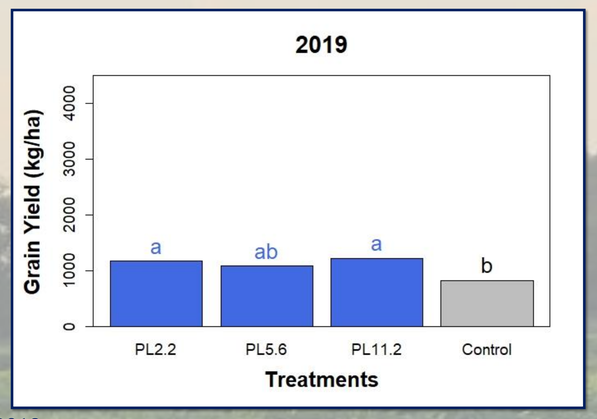


Figure 1: Effect of treatments on soybean grain yield in 2018 and 2019.

- PL significantly affected soybean grain yield only in 2019.
- However, soybean grain yield did not differ with the amount of PL application.
- The PL-treated plots had 42% greater grain yield (1156 kg ha^{-1}) than the control plots (818.50 kg ha-1).

Table 3: Test of significance of the effect of treatments on soybean grain nutrient concentration.

Year	N	P	K	Mg	Ca	S	B	Zn	Mn	Fe	Cu
					p > F						
2018	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
2019	ns	ns	s	ns	s	ns	ns	ns	ns	ns	s

**ns: non-significant; s: significant effect at P≤0.05*

Table 4: Soybean grain K, Ca, and Cu concentrations as affected by treatments.

Treatment	K	Ca	Cu
PL2.2	19.77bc	3.75a	13.25c
PL5.6	20.8ab	3.57b	14.75b
PL11.2	21.57a	3.6ab	16.5a
Control	19.92bc	3.67ab	14.25bc

- Treatments had no significant effect on grain nutrient composition in 2018 but in 2019, treatments greatly influenced grain K, Ca, and Cu concentrations.
- The PL11.2 treatment resulted in highest grain K and Cu concentrations, significantly different from the PL2.2 and the control treatments.
- No significant difference in grain Ca concentration was obtained between individual PL treatments and the control.

CONCLUSION

- PL effectively increased soybean grain yield in the succeeding year. This could be likely due to the carryover effect of nutrients from the previous PL application.
- PL didn't enriched soybean grain with any of the mineral elements when applied at 2.2 or 5.6 Mg ha^{-1} in both years.
- However, periodic PL application at 11.2 Mg ha^{-1} may enrich grains with some of the mineral elements (K and Cu).

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