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Crop Management

Should cotton growers apply full nitrogen rate when using broiler-litter as soil amendment?

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Abstract

Nitrogen plays a critical role in cotton (*Gossypium hirsutum* L.) production. Interest in using broiler (*Gallus gallus domesticus*) litter has increased in recent years due to its nutrient and soil health benefits. However, growers typically do not discount the N present in broiler litter and apply a full dose of fertilizer N. A five site-years field study was conducted to assess the effects of supplemental fertilizer N rate (0, 25, 45, 55, 70, and 85 lbs acre⁻¹) on broiler-litter-fertilized cotton lint yield, above-ground biomass, nutrient uptake, lint turnout, and fiber quality. Broiler litter was applied at a rate of 2 tons acre⁻¹ yr⁻¹ before planting. Six treatments were arranged in a randomized complete block design with four replications. Cotton receiving only broiler litter (i.e., zero fertilizer N treatment) did not exhibit lint yield declines relative to the combination of broiler litter and fertilizer N at low lint yield levels (864 to 1313 lbs acre⁻¹). However, a positive crop response to fertilizer N (up to 55 lbs acre⁻¹) was observed at higher mean lint yield levels (1775 to 2270 lbs acre⁻¹). Fertilizer N had no significant effect on above-ground biomass, lint turnout, or fiber quality measurements in any growing season. Overall, these results suggest that supplementing broiler-litter-fertilized cotton with fertilizer N is required for high production potential. Low-yielding broiler-litter-fertilized cotton did not respond to supplemental N.

Plain Language Summary

With increasing fertilizer prices, broiler litter application for cotton production is gaining popularity as a soil amendment and a slow-release source of plant nutrients. However, many farmers would still apply full amounts of commercial nitrogen fertilizer when using broiler litter. A study across five site-years investigated the supplemental nitrogen needed to maximize cotton lint yield with pre-plant application of broiler litter. Results showed that in low-yielding site years, broiler litter alone

Abbreviations: TVREC, Tennessee Valley Research and Extension Center; WREC, Wiregrass Research & Extension Center; BL, Broiler litter.

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was adequate (i.e., extra nitrogen did not increase cotton yield). Supplemental nitrogen fertilizer increased cotton yield in high-yielding site years. Overall, supplemental nitrogen is only beneficial when cotton has a high yield potential.

1 | INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is one of the major row crops grown in the southeastern United States. In 2025, around 33% of the total US cotton planted area (i.e., 10.1 million acres) was in the southeast region (USDA-NASS, 2025). This region also accounted for nearly 70% of the 9.33 billion broiler chickens (*Gallus gallus domesticus*) produced in the United States in 2024 (USDA-NASS, 2025). Due to intensive broiler production, an estimated 15.4 million tons of broiler litter (BL, a mixture of mainly chicken feces and organic bedding materials) is generated in the region (3.31 lbs litter per broiler; Moore, 1998). Broiler litter is a valuable source of nitrogen (N) and other macro- and micro-nutrients essential for crop growth (Watts et al., 2019). Additionally, application of BL to cropland improves soil physical (Brye et al., 2004), chemical (Watts et al., 2010), and biological properties (Pratt & Tewolde, 2009), thereby contributing to soil health and productivity. Due to these benefits, BL is increasingly used for cotton production.

Nitrogen is usually the most limiting plant nutrient in cotton production systems. Although BL contains all essential plant nutrients, it is often used as a low-cost N source for crop production. The use of BL, commonly as a N fertilizer, to cotton has been studied for application rate (Tewolde et al., 2009a; 2007; 2016a; Tewolde et al., 2010), application method (Tewolde et al., 2009b, 2015), application time (Tewolde et al., 2015), crop rotation (Tewolde et al., 2009a), tillage (Tewolde et al., 2008), litter type (Reddy et al., 2007), and residual effects (Tewolde et al., 2016b, 2011). Previous research has indicated to limit the usage of BL to 2 tons acre⁻¹ for cotton production (Gascho et al., 2001; Millhollon et al., 2003; Tewolde et al., 2010) as applying BL repeatedly as a N source can result in soil P buildup due to small N/P ratio in BL and relatively low cotton P uptake (Tewolde et al., 2007).

Unlike conventional fertilizers, much of the N in BL occurs in organic form which is not readily available for plant uptake. It is estimated that approximately 30 to 50% of the total N applied in BL becomes plant-available by mineralization during the first crop year (CAES, 2007; Ruiz Diaz & Sawyer, 2008; Tewolde et al., 2013). Because of lower plant N availability from BL and uncertainty in timing when it will be available, application of supplemental fertilizer N would be necessary to meet cotton N demand and support optimum growth and yield. Tewolde et al. (2009a) found that 2 tons acre⁻¹ BL was inadequate for cotton in the first 2 of the 3-

yr field study conducted in a Catalpa silty clay loam soil. Fertilizing cotton with 2 tons acre⁻¹ BL and 60 lbs acre⁻¹ supplemental N as urea-ammonium nitrate solution has been shown to produce the same or greater lint yield as the farm standard fertilizer N rate in the Mississippi Delta (Tewolde et al., 2007, 2011). Reddy et al. (2004) reported improved cotton lint yield and growth with BL at 178 lbs N acre⁻¹ compared with ammonium nitrate at the rate of 89 lbs N acre⁻¹. Also, 1 tons acre⁻¹ BL without supplemental fertilizer N may be adequate for optimum cotton lint yield production when applied repeatedly to the field (Sistani et al., 2004).

As land application of BL has become a common practice in the southeastern United States, accounting for the N value of the BL will improve cotton fertilizer N management. Currently, cotton growers do not discount the N present in the BL and apply the full dose of commercial fertilizer. Furthermore, limited studies have evaluated a range of supplemental fertilizer N rates for broiler-litter-fertilized cotton (Sistani et al., 2004; Tewolde et al., 2007). The amount of supplemental fertilizer N needed for broiler-litter-fertilized cotton should be established to increase the economic, agronomic, and environmental sustainability of cotton production in the region. Therefore, the objective of this study was to evaluate broiler-litter-fertilized cotton lint yield, biomass yield, nutrient uptake, lint turnout, and fiber quality responses to supplemental fertilizer N rate.

2 | MATERIALS AND METHODS

2.1 | Study sites

The study was conducted from 2021 to 2023 at the Auburn University Wiregrass Research & Extension Center (WREC) near Headland, AL in an Orangeburg sandy loam (fine-loamy, kaolinitic, thermic Typic Kandiudults) and during the 2022 and 2023 growing seasons at the Tennessee Valley Research and Extension Center (TVREC) near Belle Mina, AL in a Decatur silt loam soil (clayey, kaolinitic, thermic Rhodic Paleudult). Before initiating the study, background soil samples ($n = 5$) were taken randomly at 0–6 inches depth at each location. Selected soil chemical properties are shown in Table 1. The monthly total precipitation and average air temperature for the study fields were collected from the on-site weather station (Table 2).

TABLE 1 Selected initial soil physical and chemical properties (0–6 inches depth) at Wiregrass Research & Extension Center (WREC) and Tennessee Valley Research & Extension Center (TVREC).

Location	pH	Sand	Silt	Clay	Total N	Total C	Mehlich-1 P	Mehlich-1 K	Mehlich-1 Mg	Mehlich-1 Ca
				%					lbs acre ⁻¹	
WREC	7.3	82	3	15	0.05	0.63	60	116	72	464
TVREC	5.9	19	61	20	0.12	1.18	46	222	140	2930

2.2 | Treatments and experimental design

Six treatments were tested in a randomized complete block design replicated four times. Treatments included fertilization with pre-plant 2 tons acre⁻¹ yr⁻¹ BL supplemented with 0, 25, 45, 55, 70, and 85 lbs acre⁻¹ fertilizer N at first square growth stage. In Alabama, 90 lbs N acre⁻¹ is a recommended annual rate for cotton production (AAES, 2012).

2.3 | Treatment application

Fresh BL was obtained each year from a local broiler chicken operation nearby to the study sites. The moisture and nutrient concentrations of the BL used each site-year are shown in Table 3. Broiler litter was surface broadcasted by hand within two weeks before planting each year (Table 4).

The fertilizer N source was urea (46–0–0, N–P₂O₅–K₂O) surface-applied by hand at the first square stage (36 to 48 days after planting). All plots also received 50 lbs K acre⁻¹ as muriate of potash (0–0–60) each year due to high K requirement of cotton. The K fertilizer was applied as a surface-broadcast by hand along with supplemental N. No other nutrients were applied over the study period.

2.4 | Agronomic management

The WREC field was managed in a strip-till system, whereas the TVREC field was under no-till for rainfed cotton production. Each plot consisted of four 20 ft-long rows spaced 36 inches apart at WREC and four 25 ft-long rows spaced 40 inches apart at TVREC. The plots received the same treatment each year. Previous crops were cotton and corn (*Zea Mays* L.) at WREC and TVREC, respectively with no history of BL application at either field. Weed control and insect pest management was achieved by following local guidelines (IMP-0415, 2023). Cotton was followed by cereal rye (*Secale cereale* L.) cover crop in the fall.

2.5 | Measurements

End-of-season whole cotton plants were harvested from a 3.3-ft length of the outer two rows of each plot to assess biomass and nutrient accumulation. Plant samples were cut at the soil surface and separated into leaves, stems, and bolls. The mature opened bolls were further separated into bur and lint + seed. Plant parts were dried in a forced-air oven at 176°F to a constant weight, weighed, and ground using a Wiley Model 4 mill (Thomas Scientific, Swedesboro, NJ) to pass a 0.04-in sieve. Most of the unopened bolls opened during the drying time and

TABLE 2 Monthly total precipitation and average air temperature during cotton growing season at Wiregrass Research & Extension Center (WREC) in 2021–2023 and Tennessee Valley Research & Extension Center (TVREC) in 2022–2023.

Location	Year	May	June	July	Aug.	Sept.	Oct.	Total/mean
Precipitation, inches								
WREC	2021	3.0	3.8	8.3	6.6	2.5	3.6	27.9
	2022	3.6	4.1	1.9	3.5	0.9	2.0	15.9
	2023	0.9	1.1	3.3	3.2	3.6	1.1	13.1
TVREC	2022	4.2	0.4	3.7	2.6	3.2	2.3	16.4
	2023	1.9	1.4	5.0	5.6	1.2	0.4	15.3
Air temperature, °F								
WREC	2021	73	80	81	81	76	69	77
	2022	75	81	81	79	76	65	76
	2023	72	78	82	83	76	67	76
TVREC	2022	73	79	83	79	72	59	74
	2023	70	76	79	79	73	64	73

were separated accordingly. Cotton was picked from the entire length of the middle two rows of each plot using a two-row picker equipped with a self-weighing basket. Lint yield was calculated from the harvested plot seed cotton yield and lint turnout. Seeds were separated from lint by ginning approximately 0.5-lbs subsamples on a 10-saw bench-top gin. Lint turnout was calculated as follows:

$$100 \times \frac{\text{weight of lint}}{\text{weight of lint} + \text{seed} + \text{trash}}$$

After ginning, samples of cotton fiber were sent to the USDA Memphis, TN classing office for determination of quality parameters including fiber length, strength, micronaire, length uniformity, degree of reflectance, and yellowness.

Dried plant samples were shipped to Waters Agricultural Laboratories (Camilla, GA) for analysis. Plant tissue total N concentration was determined by an automated dry combustion method. Concentrations of P, K, Ca, and Mg in grounded plant samples were determined by digesting sample in a digestion block with concentrated nitric acid at 203°F for 90 minutes (Isaac & Johnson, 1985). The resulting digested solutions were then filtered and analyzed by inductively coupled plasma optical emission spectrometer (ICP–OES).

2.6 | Statistical analysis

The data collected for each site-year were analyzed independently using the GLIMMIX procedure of SAS 9.4 (SAS Institute, Cary, NC) because of residual effect of repeated BL application and significant supplemental N rate $\times$ site-year interactions for yield ($p = 0.0409$) and biomass ($p = 0.0002$). The supplemental N rate was considered as a fixed effect

and replication as random effect. Significant differences between two treatment means were determined using the adjust = Tukey option in LSMEANS at $p \leq 0.05$.

3 | RESULTS AND DISCUSSION

3.1 | Weather summary

Weather conditions, particularly precipitation, differed considerably over the years at both locations (Table 2). The 2021 growing season was relatively wetter than the 2022 and 2023 growing seasons. All growing seasons except WREC 2021 received less rainfall than the typical total water requirement of 17.7 in for cotton in the southeastern USA (Bednarz et al., 2002). Due to drought, the WREC plots received 6.9- and 7.2-in supplemental irrigation in 2022 and 2023, respectively. The drought rescue irrigation was applied solely to prevent crop failure rather than influence nutrient response. However, no supplemental irrigation was provided at TVREC due to inoperable center-pivot irrigation system. The most critical cotton growth period of June, July, and August received a cumulative rainfall of 18.7, 9.4, 7.6, 6.7, and 11.9 in, equivalent to 67, 59, 58, 41, and 78% of total growing season rainfall at WREC 2021, WREC 2022, WREC 2023, TVREC 2022, and TVREC 2023, respectively. Mean growing season air temperatures were within 1°F across all site-years.

3.2 | Lint yield

The substantial differences in precipitation amount and pattern for the growing seasons greatly impacted the lint yield (Figure 1).

TABLE 3 Nutrient analysis of broiler litter applied to cotton at Wiregrass Research & Extension Center (WREC) in years 2021–2023 and Tennessee Valley Research & Extension Center (TVREC) in 2022–2023.

Location	Year	Moisture	C	N	P	K	Ca	Mg	Cu	Fe	Mn	Zn
WREC					%						mg kg ⁻¹	
	2021	33.1	32.2	2.71	1.23	2.97	1.79	0.87	595	3094	382	400
	2022	31.6	26.1	2.10	0.79	1.92	1.15	0.51	271	2069	277	225
	2023	16.3	36.2	2.77	0.95	2.11	1.49	0.55	331	1560	290	264
	Average	27.0	31.5	2.53	0.99	2.33	1.48	0.64	399	2241	316	296
TVREC	SD ^a	9.3	5.1	0.37	0.22	0.56	0.32	0.20	172	781	57	92
	2022	32.3	30.6	2.98	0.91	2.51	1.54	0.54	283	773	417	234
	2023	26.6	–	3.24	1.87	4.65	3.71	0.95	398	568	832	528
	Average	29.5	30.6	3.11	1.39	3.58	2.63	0.75	341	671	625	381
	SD	4.0	–	0.18	0.68	1.51	1.53	0.29	81	145	293	208

^aStandard deviation.

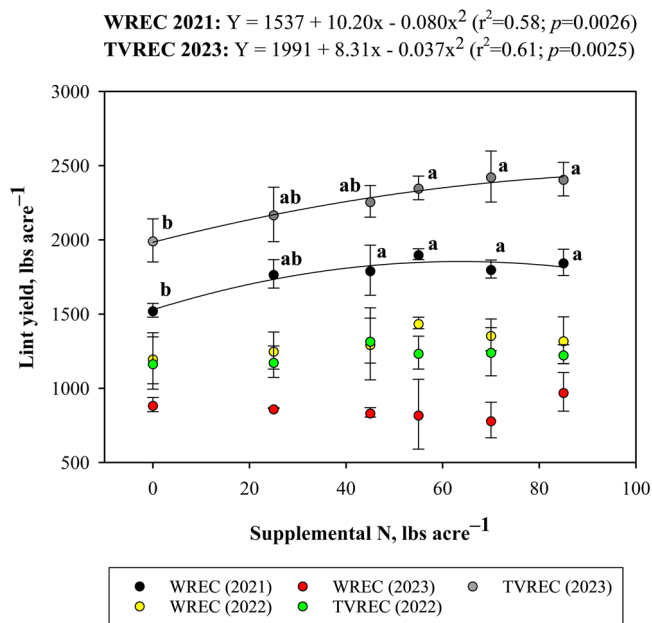


FIGURE 1 Cotton lint yield as affected by supplemental N application rate with 2 tons acre⁻¹ broiler litter as starter fertilizer at Wiregrass Research & Extension Center (WREC) in 2021–2023 and Tennessee Valley Research & Extension Center (TVREC) in 2022–2023. The solid black line represents the quadratic relationship between lint yield and supplemental N application rate. Different letters within a site-year signify statistical differences at $p \leq 0.05$. Error bars denote standard deviation of the means.

The mean lint yield ranged from 864 to 1775 lbs acre⁻¹ at WREC and 1231 to 2270 lbs acre⁻¹ at TVREC. The lowest lint yield at WREC occurred in 2023 largely because the growing season was the driest across years. At TVREC, the crop suffered drought stress in 2022 due to low June rainfall received, causing a 46% reduction in lint yield compared to 2023 (Table 2). Previous studies have reported yield reduction in the range of 7% to 49% for water-stressed cotton (Hu et al., 2018; Karademir et al., 2011). Drought results in reduced turgor pressure, inhibiting cell elongation and overall plant growth (Gao et al., 2020). Shorter cotton plants with decreased total mainstem nodes and node of the uppermost harvestable boll, early maturity, and fewer fruiting sites have been observed under low soil moisture availability (Hearn, 1980; Meeks et al., 2017; Pace et al., 1999; Prasad et al., 2022).

Significant lint yield response to supplemental N was only observed in 2 of the 5 site-years i.e., WREC 2021 and TVREC 2023 (Table 5). At WREC 2021, maximum lint yield of 1904 lbs acre⁻¹ for the 55 lbs N acre⁻¹ treatment was significantly higher than 1526 lbs acre⁻¹ observed for the 0 lbs N acre⁻¹ treatment but statistically equivalent for the other four supplemental N treatments. At TVREC 2023, 70 lbs acre⁻¹ supplemental N produced the highest lint yield (2427 lbs acre⁻¹), significantly higher than 0 kg N ha⁻¹ treatment (1997

TABLE 4 Cotton hybrid and selected crop management dates at Wiregrass Research & Extension Center (WREC) in 2021–2023 and Tennessee Valley Research & Extension Center (TVREC) in 2022–2023.

Location	Year	Broiler litter application	Planting	Cultivar	Side-dress N and K application	Harvest
WREC	2021	May 14	May 20	DP 2038	June 30	October 29
	2022	May 18	May 31	DP 2038	July 6	October 25
	2023	May 3	May 16	DP 2020 B3XF	June 29	October 26
TVREC	2022	May 13	May 20	DP 2012 B3XF	July 7	October 14
	2023	April 24	May 10	DP 2012 B3XF	June 27	October 3

lbs acre⁻¹) but similar when compared to the 25, 45, 55, and 85 lbs N acre⁻¹ treatments. The response or no-response of lint yield to supplemental N may be explained by lint yield levels of the site years. When the supplemental N had no impact on lint yield, mean lint yields were relatively lower (mainly due to reduced soil water supply). Thus, where the yield expectations are low due to limited soil water availability or other factors, BL at 2 tons acre⁻¹ yr⁻¹ without supplemental N may be adequate for typical cotton production. However, WREC 2021 and TVREC 2023 results indicated that supplemental N up to 55 lbs acre⁻¹ may be needed to support lint yields in a high production environment. Nitrogen is a key component of plant proteins, enzymes, and chlorophyll molecules and thus influences cotton vegetative and reproductive growth (Snider et al., 2021; Zhang et al., 2012). At high yield levels, cotton plants have increased fruiting branch development, fruiting sites, number of bolls, and leaf area expansion, which acts as a major sink for N, increasing yield response to N depending on the initial soil N levels (Read et al., 2006). Yield potential is increasing over time as crop genetics and management improve, but is strongly influenced by local conditions such as rainfall, soil water storage, nutrition, weeds, diseases, and pests (Constable & Bange, 2015). Furthermore, there were high variations in the nutrient concentrations among BLs used for this study. For example, N concentrations ranged from 2.10–3.24% N on an as-sampled wet basis. This variability, heavily influenced by management practices in broiler houses, could potentially influence cotton response to supplemental N if the BL is applied at greater rates. Most farmers do not apply more than 2 tons acre⁻¹ due to cost-effectiveness, owing to the bulky nature of BL. However, if the BL has higher N content, producers will need to apply less supplemental N to meet cotton N requirements. Consequently, broiler-litter-fertilized cotton response to supplemental N can vary between application rates and production environments. Sistani et al. (2004) found no differences in cotton lint yield among supplemental N rates (up to 90 lbs N acre⁻¹) in addition to 1 tons acre⁻¹ yr⁻¹ BL application, whereas Tewolde et al. (2007) recommended supplementing 2 tons acre⁻¹ BL with 60 lbs acre⁻¹ fertilizer N to produce the highest cotton lint yield.

3.3 | Biomass yield and nutrient uptake

Many studies have reported positive association between seasonal biomass accumulation and N application rate (Boquet & Breitenbeck, 2000; Chen et al., 2018; Reddy et al., 2004). Interestingly, the supplemental N application did not affect total aboveground plant biomass at WREC (Table 5), which suggests that 2 tons acre⁻¹ BL application before planting provided adequate N for cotton.

This could be related to efficient mineralization of BL N and/or repeated application of litter to the same site over 3 years. In contrast, Pokhrel et al. (2023) reported a positive biomass yield response to N application rate up to 160 lbs acre⁻¹ (without BL application) on a similar soil type (i.e., Tifton loamy sand in South Georgia). The growing conditions seemed more favorable for cotton in their study as greater biomass production (9603 to 17166 lbs dry matter acre⁻¹) was reported. By comparison, biomass yield at WREC averaged across all treatments ranged from 6836 lbs acre⁻¹ in 2021 to 8977 lbs acre⁻¹ in 2023. At TVREC, plant biomass was significantly affected by supplemental N application only in 2023. Unlike lint yield, fertilizing cotton with 70 and 85 lbs acre⁻¹ supplemental N greatly increased biomass yield over the lower N rates, whereas biomass yield for 0, 25, 45, and 55 lbs supplemental N acre⁻¹ was statistically equivalent. Tissue N concentrations also did not respond to increasing rates of supplemental N fertilization across all site-years (Table 5).

Similar results were observed in seed and total plant nutrient uptake at maturity (Table 6).

Application of 70 or 85 lbs N acre⁻¹ did not significantly influence the seed and total plant nutrient uptake compared to 0 lbs N acre⁻¹ at WREC 2022, WREC 2023, and TVREC 2022. The WREC showed lower seed and total plant nutrient uptake values in 2023 than in 2022 due to reduced biomass yield. Of the total plant nutrient uptake across site-years and treatments (excluding WREC 2021 and TVREC 2022 due to missing data), N, P, K, Mg, and Ca uptake in cotton seed ranged from 16 to 51, 17 to 50, 9 to 18, 11 to 46, and 2 to 5%, respectively. These values were like those reported in previous studies except for WREC 2023 (Boquet & Breitenbeck, 2000; Mullins & Burmester, 1990; Singh et al., 2024). Lower assim-

TABLE 5 Cotton lint yield, biomass yield, lint turnout, and plant tissue N concentration as affected by supplemental N application rate (0 to 85 lbs acre⁻¹) with 2 tons acre⁻¹ broiler litter as starter fertilizer at Wiregrass Research & Extension Center (WREC) in 2021–2023 and Tennessee Valley Research & Extension Center (TVREC) in 2022–2023.

Location	Year	Supplemental N	Lint yield lbs acre ⁻¹	Biomass yield	Turnout	N concentration		
						Leaf	Stem	Seed
WREC	2021	0	1526b	6169	50.2	3.01	1.19	–
		25	1771ab	6293	50.3	2.95	1.37	–
		45	1796a	6798	50.0	2.43	1.28	–
		55	1904a	6514	50.2	2.70	1.43	–
		70	1804a	7185	49.0	2.47	1.57	–
	2022	85	1849a	8060	49.5	2.55	1.42	–
		<i>p</i> > <i>F</i>	0.0026	0.2876	0.2951	0.8870	0.6770	–
		0	1202	8750	48.6	2.85b	1.03	3.67
		25	1254	8958	46.3	2.90b	1.01	3.62
		45	1299	9766	45.8	3.25ab	1.23	4.01
		55	1440	9656	46.9	3.01ab	1.14	3.76
		70	1360	8446	45.7	3.29ab	1.11	3.85
		85	1324	8285	46.3	3.43a	1.27	3.93
		<i>p</i> > <i>F</i>	0.3369	0.2182	0.1649	0.0035	0.3336	0.8044
		0	890	6376	42.2	2.99	0.86	1.93
	2023	25	865	7136	42.3	2.78	0.86	2.30
		45	837	8062	41.6	3.02	0.85	1.80
		55	825	8180	41.0	2.86	0.81	2.27
		70	786	8448	42.0	3.03	0.91	2.45
		85	975	7213	42.0	2.98	0.97	1.98
TVREC	2022	<i>p</i> > <i>F</i>	0.3562	0.1595	0.0746	0.3772	0.5543	0.1981
		0	1170	5212 ^a	45.2	–	1.30	3.64ab
		25	1179	5399	43.5	–	1.12	3.10b
		45	1321	5448	44.7	–	1.21	3.46ab
		55	1240	5188	44.9	–	1.16	3.45ab
		70	1246	5527	45.4	–	1.23	4.06a
		85	1229	6470	44.2	–	1.31	3.80a
		<i>p</i> > <i>F</i>	0.5253	0.1280	0.3148	–	0.3315	0.0064

(Continues)

TABLE 5 (Continued)

Location	Year	Supplemental N	Lint yield lbs acre ⁻¹	Biomass yield	Turnout	N concentration		
						Leaf	Stem	Seed
	2023	0	1997b	7955c	48.4	2.15	0.68	2.05
		25	2172ab	8804c	47.8	1.97	0.68	2.44
		45	2260ab	8695c	47.5	2.01	0.62	1.97
		55	2351a	9603bc	47.6	2.08	0.74	2.18
		70	2427a	11613ab	48.2	2.08	0.66	2.4
		85	2410a	12699a	48.2	2.13	0.76	2.17
		$p > F$	0.0025	<0.0001	0.4225	0.0964	0.0940	0.2179

Note: Means with a letter in common within each column and location year are not significantly different at the 5% level ($p < 0.05$) according to Tukey's HSD test.

^aExcluding weight of leaves.

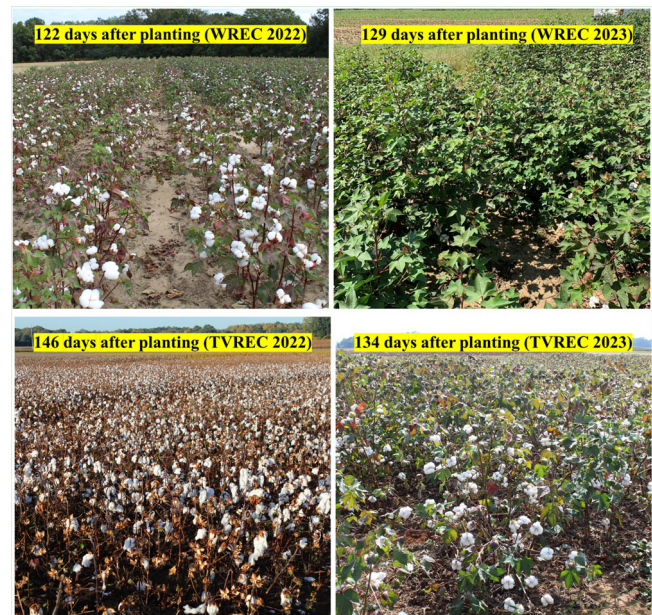


FIGURE 2 Relative cotton maturity at Wiregrass Research & Extension Center (WREC) and Tennessee Valley Research & Extension Center (TVREC) in 2022–2023.

ilation rates in cotton seed at WREC 2023 could be related to hybrid remobilization characteristics and sampling time relative to crop maturity. At WREC 2023, the cotton bolls were relatively premature during plant sampling (Figure 2).

3.4 | Lint turnout and fiber quality

There was no significant effect of supplemental N application rate on lint turnout regardless of site-year (Table 5). Treatments that received BL with supplemental urea-N had statistically the same lint turnout as the BL alone treatment. Nitrogen fertilization has been shown to affect lint turnout in previous studies (Tewolde et al., 2008, 2009b, 2010). For instance, on a Loring silt loam soil in northern Mississippi, Tewolde et al. (2010) observed decreasing cotton lint turnout with increasing rates of applied N. In another soil type of Mississippi i.e., Marietta fine sandy loam, fertilizing cotton with 90 or 105 lbs N acre⁻¹ significantly decreased lint turnout compared to unfertilized control (Tewolde et al., 2009b). Under-fertilized cotton usually has higher lint turnout due to reduced seed growth (Boman et al., 1997; Fritsch et al., 2003; Tewolde et al., 2007). Lint turnout results from this study suggest that N nutrition was similar among the treatments. Reflecting differences in growing conditions, mean lint turnout was 49.9, 46.6, 41.8, 44.6, and 47.9% for WREC 2021, WREC 2022, WREC 2023, TVREC 2022, and TVREC 2023, respectively, which is consistent with research findings of Tewolde et al. (2007) and Watts & Way (2023).

TABLE 6 Cotton total plant and seed N, P, K, Mg, and Ca uptake as affected by supplemental N application rate (0 to 85 lbs acre⁻¹) with 2 tons acre⁻¹ broiler litter as starter fertilizer at Wiregrass Research & Extension Center (WREC) and Tennessee Valley Research & Extension Center (TVREC) in 2022–2023.

Location	Year	Supplemental N	N uptake		P uptake		K uptake		Mg uptake		Ca uptake	
			Seed	Total	Seed	Total	Seed	Total	Seed	Total	Seed	Total
WREC	2022	0	61	127b	4.3	11.2	19	123b	3.9	13.3	2.3	55
		25	66	131b	4.7	10.6	21	124b	4.4	13.7	2.7	56
		45	79	164a	3.9	11.6	22	161a	4.1	15.3	2.8	65
		55	64	144ab	3.4	10.1	20	148ab	3.8	14.3	2.7	63
		70	68	137ab	5.3	11.2	21	127ab	4.6	14.2	2.6	54
	2023	85	78	153ab	3.7	9.5	21	134ab	3.7	13.0	2.4	57
		<i>p</i> > <i>F</i>	0.0949	0.0188	0.6248	0.4747	0.7192	0.0190	0.7660	0.5960	0.8523	0.5473
		0	21	74	4.2	16.4	12	69b	2.4	14.3	2.1	95
		25	22	87	4.3	19.4	11	86ab	2.4	13.4	1.7	79
		45	16	102	3.3	20.6	11	97ab	2.1	15.2	1.7	104
TVREC	2022 ^a	55	18	105	3.3	18.6	11	113a	2.1	18.7	1.8	97
		70	21	109	4.4	19.4	12	103ab	2.6	16.1	2.1	90
		85	20	103	3.8	18.3	12	87ab	2.2	13.4	1.8	84
		<i>p</i> > <i>F</i>	0.3167	0.0706	0.4671	0.4010	0.8792	0.0249	0.5668	0.3494	0.4890	0.4419
		0	53bc	79b	4.6b	7.5b	14	56	3.7	7.7ab	2.9	32ab
	2023	25	48c	73b	5.5ab	8.4ab	16	54	3.5	6.8b	2.8	29b
		45	52bc	80b	7.2ab	10.5ab	16	60	4.3	8.5ab	3.1	33ab
		55	48c	75b	7.6ab	10.6ab	15	54	3.8	7.5ab	2.8	29b
		70	60ab	90ab	8.0ab	11.2ab	15	61	4.1	8.3ab	2.9	32ab
		85	67a	104a	9.4a	12.8a	19	71	5.4	10.4a	3.7	40a
	<i>p</i> > <i>F</i>	0.0004	0.0009	0.0304	0.0299	0.1890	0.2281	0.2440	0.0386	0.0573	0.0301	
		0	34b	84c	9.8	22.2	19b	103c	4.5b	10.3b	2.9ab	80b
		25	38b	87c	10.2	20.6	20b	117c	4.9ab	10.8b	3.0ab	79b
		45	34b	81c	9.2	17.7	20b	117c	4.4b	10.2b	2.9b	78b
		55	37b	95bc	9.3	19.8	21b	126bc	4.8ab	11.8ab	3.2ab	95ab
		70	43ab	122ab	9.8	22.7	22b	157ab	5.2ab	14.7a	3.2ab	142a
		85	50a	129a	11.8	24.2	28a	174a	6.2a	14.5a	3.8a	117ab
		<i>p</i> > <i>F</i>	0.0387	<0.0001	0.4570	0.1156	0.0002	<0.0001	0.0383	0.0107	0.0277	0.0159

Note: Means with a letter in common within each column and location year are not significantly different at the 5% level ($p < 0.05$) according to Tukey's HSD test.

^aTotal plant nutrient uptake does not include leaf uptake.

TABLE 7 Cotton fiber quality as affected by supplemental N application rate (0 to 85 lbs acre⁻¹) with 2 tons acre⁻¹ broiler litter as starter fertilizer at Wiregrass Research & Extension Center (WREC) in 2021–2023 and Tennessee Valley Research & Extension Center (TVREC) in 2022–2023.

Location	Year	Supplemental N	Length	Strength	Micronaire	Uniformity	Reflectance	Yellowness
		lbs acre ⁻¹	inches	g tex ⁻¹		%		
WREC	2021	0	1.11	30.0	4.6	82.8	72.0	6.8
		25	1.11	30.3	4.8	82.6	70.6	6.8
		45	1.11	30.7	4.6	82.7	71.2	6.6
		55	1.12	29.9	4.7	83.2	71.0	6.7
		70	1.13	29.9	4.7	83.3	71.0	6.7
		85	1.11	29.0	4.7	82.3	70.9	6.8
		<i>p</i> > F	0.5051	0.8465	0.8791	0.5629	0.4417	0.9107
	2022	0	1.09	30.3	4.9	83.8	77.5	8.6
		25	1.08	30.4	4.9	83.7	77.5	8.5
		45	1.10	30.6	4.7	83.6	77.6	8.6
		55	1.09	30.6	4.9	83.9	77.2	8.5
		70	1.12	30.5	4.7	84.6	78.5	8.7
		85	1.08	30.1	4.7	83.7	77.8	8.5
		<i>p</i> > F	0.2664	0.9700	0.6985	0.2285	0.3330	0.8582
	2023	0	1.15	31.5	3.9	80.9	77.4	10.6
		25	1.12	30.1	4.0	81.9	76.6	10.8
		45	1.15	31.3	4.0	80.9	75.1	11.9
		55	1.11	31.4	3.7	81.6	74.8	10.9
		70	1.10	29.0	4.0	79.0	76.3	10.7
		85	1.16	31.2	4.1	81.0	77.4	10.3
		<i>p</i> > F	0.2523	0.1123	0.2846	0.1763	0.0877	0.2502
TVREC	2022	0	1.16	31.3	4.6	84.9	78.0	8.7
		25	1.15	31.1	4.9	85.2	79.4	8.6
		45	1.18	31.4	4.6	84.6	77.9	8.5
		55	1.18	31.2	4.8	85.2	79.5	8.7
		70	1.16	31.0	4.8	84.5	78.9	8.8
		85	1.17	31.1	4.7	84.7	77.7	8.8
		<i>p</i> > F	0.7310	0.9466	0.5273	0.6610	0.5761	0.8487
	2023	0	1.12	28.5	4.6	83.1	78.1	12.4
		25	1.12	30.0	4.4	82.6	77.5	13.2
		45	1.15	29.9	4.4	83.1	77.3	13.6
		55	1.15	29.6	4.6	83.3	78.0	12.9
		70	1.14	29.4	4.7	82.0	76.7	13.8
		85	1.13	29.9	4.7	82.2	77.1	13.6
		<i>p</i> > F	0.2302	0.5107	0.6289	0.4963	0.8130	0.3932

Note: Means with a letter in common within each column and location year are not significantly different at the 5% level ($p < 0.05$) according to Tukey's HSD test.

Like lint turnout, supplemental N had no significant effect on fiber quality measurements in any site-year (Table 7).

Previous studies have reported varied response of fiber quality parameters to N application across years or locations (Bauer et al., 1993; Fritschi et al., 2003; Snider et al., 2021; Sui et al., 2017; Tewolde et al., 2007). For instance, Pokhrel et al. (2023) reported that N application affected fiber micron-

aire for field-grown cotton in Tifton, Georgia. In another field experiment in Tifton, Georgia, fiber micronaire was affected by N rate only in one of the two years (Snider et al., 2021). Fiber uniformity and strength were unaffected by N rate in either study, in line with our data. Watts & Way (2023) reported no effect of N fertilization on cotton fiber properties at the outdoor soil bins experiment conducted in Auburn,

Alabama. For all treatments and site-years averaged, fiber length was 1.13 in, strength was 30.4 g tex⁻¹, micronaire was 4.5, uniformity was 83.0%, reflectance degree was 76.2, and yellowness index was 9.6. For comparison, the upland base quality for cotton is fiber length 1.05 to 1.07 in, strength 27.0 to 28.9 g tex⁻¹, micronaire 3.5, 3.6 and 4.3 to 4.9, and uniformity ratio 81.0 to 81.9% (USDA-AMS, 2023).

4 | CONCLUSION

Broiler litter is a well-known soil amendment and valuable source of plant nutrients; however, cotton growers are unsure whether supplemental N would be needed when using BL to achieve the full lint yield potential. The objective of our study was to assess the effects of supplemental N application on broiler-litter-fertilized cotton lint yield, above-ground biomass, nutrient uptake, lint turnout, and fiber quality. Cotton receiving only broiler litter at a conservative rate of 2 tons acre⁻¹ did not exhibit lint yield declines relative to the combination of BL and supplemental fertilizer N at low levels of lint yield (864 to 1313 lbs acre⁻¹). However, positive crop response to supplemental N fertilizer (up to 55 lbs acre⁻¹) was observed with high mean lint yield levels (1775 to 2270 lbs acre⁻¹). Across all site-years, supplemental N had no significant effect on above-ground biomass, lint turnout, and fiber quality measurements. This study demonstrates that broiler litter can adequately supply N for cotton in low-yield years, and supplemental N offered no yield or fiber quality advantages.

AUTHOR CONTRIBUTIONS

Rajveer Singh: Formal analysis; methodology; visualization; writing—original draft. **Rishi Prasad:** Conceptualization; funding acquisition; investigation; project administration; resources; writing—review and editing.

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CONFLICT OF INTEREST STATEMENT

The authors confirm there are no conflicts of interest.

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REFERENCES

- AAES. (2012). Nutrient recommendation tables for Alabama crops. <https://aaes.auburn.edu/wp-content/uploads/sites/2/sites/2/2020/07/ay-324B.pdf>
- Bauer, P. J., Camberato, J. J., & Roach, S. H. (1993). Cotton yield and fiber quality response to green manures and nitrogen. *Agronomy Journal*, 85, 1019–1023. <https://doi.org/10.2134/agronj1993.000219620085000500012x>
- Bednarz, C., Ritchie, G., Hook, J., Yager, R., Cromer, S., Cook, D., & Griner, I. (2002). Cotton crop water use and irrigation scheduling. <http://www.ugacotton.com/vault/rer/2003/p72.pdf>
- Boman, R. K., Raun, W. R., Westerman, R. L., & Banks, J. C. (1997). Long-term nitrogen fertilization in short-season cotton: Interpretation of agronomic characteristics using stability analysis. *Journal of Production Agriculture*, 10, 580–585. <https://doi.org/10.2134/jpa1997.0580>
- Boquet, D. J., & Breitenbeck, G. A. (2000). Nitrogen rate effect on partitioning of nitrogen and dry matter by cotton. *Crop Science*, 40, 1685–1693. <https://doi.org/10.2135/cropsci2000.4061685x>
- Brye, K. R., Slaton, N. A., Norman, R. J., & Savin, M. (2004). Short-term effects of poultry litter form and rate on soil bulk density and water content. *Communications in Soil Science and Plant Analysis*, 35, 2311–2325. <https://doi.org/10.1081/LCSS-200030655>
- CAES. (2007). Poultry litter application on pastures and hayfields. https://secure.caes.uga.edu/extension/publications/files/pdf/B%201330_3.PDF
- Chen, Z., Tao, X., Khan, A., Tan, D. K. Y., & Luo, H. (2018). Biomass accumulation, photosynthetic traits and root development of cotton as affected by irrigation and nitrogen-fertilization. *Frontiers in Plant Science*, 9, 173. <https://doi.org/10.3389/fpls.2018.00173>
- Constable, G. A., & Bange, M. P. (2015). The yield potential of cotton (*Gossypium hirsutum* L.). *Field Crops Research*, 182, 98–106. <https://doi.org/10.1016/j.fcr.2015.07.017>
- Fritsch, F. B., Roberts, B. A., Travis, R. L., Rains, D. W., & Hutmacher, R. B. (2003). Response of irrigated Acala and Pima cotton to nitrogen fertilization: Growth, dry matter partitioning, and yield. *Agronomy Journal*, 95, 133–146. <https://doi.org/10.2134/agronj2003.1330a>
- Gao, M., Snider, J. L., Bai, H., Hu, W., Wang, R., Meng, Y., Wang, Y., Chen, B., & Zhou, Z. (2020). Drought effects on cotton (*Gossypium hirsutum* L.) fibre quality and fibre sucrose metabolism during the flowering and boll-formation period. *Journal of Agronomy and Crop Science*, 206, 309–321. <https://doi.org/10.1111/jac.12389>
- Gascho, G. J., Hubbard, R. K., Breneman, T. B., Johnson, A. W., Sumner, D. R., & Harris, G. H. (2001). Effects of broiler litter in an irrigated, double-cropped, conservation-tilled rotation. *Agronomy Journal*, 93, 1315–1320. <https://doi.org/10.2134/agronj2001.1315>
- Hearn, A. B. (1980). Water relationships in cotton. *Outlook on Agriculture*, 10, 159–166. <https://doi.org/10.1177/003072708001000402>
- Hu, W., Snider, J. L., Wang, H., Zhou, Z., Chastain, D. R., Whitaker, J., Perry, C. D., & Bourland, F. M. (2018). Water-induced variation in yield and quality can be explained by altered yield component contributions in field-grown cotton. *Field Crops Research*, 224, 139–147. <https://doi.org/10.1016/j.fcr.2018.05.013>
- IMP-0415. (2023). The cotton IPM guide. https://www.aces.edu/wp-content/uploads/2019/10/IPM-0415_Cotton2023_012523L-G.pdf
- Isaac, R. A., & Johnson, W. C. (1985). Elemental analysis of plant tissue by plasma emission spectroscopy: Collaborative study. *Journal of Association of Official Analytical Chemists*, 68, 499–505. <https://doi.org/10.1093/jaoac/68.3.499>

- Karademir, C., Karademir, E., Ekinci, R., & Berekatoğlu, K. (2011). Yield and fiber quality properties of cotton (*Gossypium hirsutum* L.) under water stress and non-stress conditions. *African Journal of Biotechnology*, 10(59), 12575–12583. <https://doi.org/10.5897/AJB11.1118>
- Meeks, C. D., Snider, J. L., Porter, W. M., Vellidis, G., Hawkins, G., & Rowland, D. (2017). Assessing the utility of primed acclimation for improving water savings in cotton using a sensor-based irrigation scheduling system. *Crop Science*, 57, 2117–2129. <https://doi.org/10.2135/cropsci2016.10.0907>
- Millhollon, E. P., Rabb, J. L., Liscano, J. F., & Anderson, R. A. (2003). Poultry litter increases cotton yields. <https://www.lsuagcenter.com/portals/communications/publications/agmag/archive/2003/spring/poultry-litter-increases-cotton-yields>
- Moore, P. A., Jr. (1998). Best management practices for poultry manure utilization that enhance agricultural productivity and reduce pollution. In J. L. Hatfield & B. A. Stewart (Eds.), *Animal waste utilization: Effective use of manure as a soil resource* (pp. 89–123). Ann Arbor Press.
- Mullins, G. L., & Burmester, C. H. (1990). Dry matter, nitrogen, phosphorus, and potassium accumulation by four cotton varieties. *Agronomy Journal*, 82, 729–736. <https://doi.org/10.2134/agronj1990.00021962008200040017x>
- Pace, P. F., Cralle, H. T., El-Halawany, S. H. M., Cothren, J. T., & Senseman, S. A. (1999). Drought-induced changes in shoot and root growth of young cotton plants. *Journal of Cotton Science*, 3, 183–187.
- Pokhrel, A., Snider, J. L., Virk, S., Sintim, H. Y., Hand, L. C., Vellidis, G., Parkash, V., Chalise, D. P., & Lee, J. M. (2023). Quantifying physiological contributions to nitrogen-induced yield variation in field-grown cotton. *Field Crops Research*, 299, 108976. <https://doi.org/10.1016/j.fcr.2023.108976>
- Prasad, D., Snider, J. L., Hand, L. C., Roberts, P., Vellidis, G., Ermanis, A., Collins, G. D., Lacerda, L. N., Cohen, Y., Pokhrel, A., Parkash, V., & Lee, J. M. (2022). Cultivar, irrigation management, and mepiquat chloride strategy: Effects on cotton growth, maturity, yield, and fiber quality. *Field Crops Research*, 286, 108633. <https://doi.org/10.1016/j.fcr.2022.108633>
- Pratt, R. G., & Tewolde, H. (2009). Soil fungal population levels in cotton fields fertilized with poultry litter and their relationships to soil nutrient concentrations and plant growth parameters. *Applied Soil Ecology*, 41, 41–49. <https://doi.org/10.1016/j.apsoil.2008.08.008>
- Read, J. J., Reddy, K. R., & Jenkins, J. N. (2006). Yield and fiber quality of Upland cotton as influenced by nitrogen and potassium nutrition. *European Journal of Agronomy*, 24, 282–290. <https://doi.org/10.1016/j.eja.2005.10.004>
- Reddy, K. C., Malik, R. K., Reddy, S. S., & Nyakatawa, E. Z. (2007). Cotton growth and yield response to nitrogen applied through fresh and composted poultry litter. *Journal of Cotton Science*, 11, 26–34.
- Reddy, K. R., Nyakatawa, E. Z., & Reeves, D. W. (2004). Tillage and Poultry Litter Application Effects on Cotton Growth and Yield. *Agronomy Journal*, 96, 1641–1650. <https://doi.org/10.2134/agronj2004.1641>
- Ruiz Diaz, D. A., & Sawyer, J. E. (2008). Plant-available nitrogen from poultry manure as affected by time of application. *Agronomy Journal*, 100, 1318–1326. <https://doi.org/10.2134/agronj2008.0010>
- Singh, J., Gamble, A., Brown, S., Campbell, T. B., Jenkins, J., Koebernick, J., Bartley, III, P. C., & Sanz-Saez, A. (2024). Exploring 65 years of progress in cotton nutrient uptake, efficiency and partitioning in the USA. *Field Crops Research*, 305, 109189. <https://doi.org/10.1016/j.fcr.2023.109189>
- Sistani, K. R., Rowe, D. E., Johnson, J., & Tewolde, H. (2004). Supplemental nitrogen effect on broiler-litter-fertilized cotton. *Agronomy Journal*, 96, 806–811. <https://doi.org/10.2134/agronj2004.0806>
- Snider, J., Harris, G., Roberts, P., Meeks, C., Chastain, D., Bange, M., & Virk, G. (2021). Cotton physiological and agronomic response to nitrogen application rate. *Field Crops Research*, 270, 108194. <https://doi.org/10.1016/j.fcr.2021.108194>
- Sui, R., Byler, R. K., & Delhom, C. D. (2017). Effect of nitrogen application rates on yield and quality in irrigated and rainfed cotton. *Journal of Cotton Science*, 21, 113–121. <https://doi.org/10.56454/XZQP5457>
- Tewolde, H., Adeli, A., Rowe, D. E., & Sistani, K. R. (2011). Cotton lint yield improvement attributed to residual effect of repeated poultry litter application. *Agronomy Journal*, 103, 107–112. <https://doi.org/10.2134/agronj2010.0274>
- Tewolde, H., Adeli, A., Sistani, K. R., Rowe, D. E., & Johnson, J. R. (2010). Equivalency of broiler litter to ammonium nitrate as a cotton fertilizer in an upland soil. *Agronomy Journal*, 102, 251–257. <https://doi.org/10.2134/agronj2009.0244>
- Tewolde, H., Armstrong, S., Way, T. R., Rowe, D. E., & Sistani, K. R. (2009b). Cotton response to poultry litter applied by subsurface banding relative to surface broadcasting. *Soil Science Society of America Journal*, 73, 384–389. <https://doi.org/10.2136/sssaj2008.0127>
- Tewolde, H., Buehring, N., Adeli, A., Sistani, K. R., Rowe, D. E., & Pratt, R. G. (2009a). Cotton response to chicken litter in rotation with corn in clayey soil. *Agronomy Journal*, 101, 626–634. <https://doi.org/10.2134/agronj2008.0154x>
- Tewolde, H., McLaughlin, M. R., Way, T. R., & Jenkins, J. N. (2016a). Optimum poultry litter rates for maximum profit versus yield in cotton production. *Crop Science*, 56, 3307–3317. <https://doi.org/10.2135/cropsci2016.04.0257>
- Tewolde, H., Shankle, M. W., Sistani, K. R., Adeli, A., & Rowe, D. E. (2008). No-till and conventional-till cotton response to broiler litter fertilization in an upland soil: Lint yield. *Agronomy Journal*, 100, 502–509. <https://doi.org/10.2134/agronj2007.0137>
- Tewolde, H., Shankle, M. W., Way, T. R., Adeli, A., Brooks, J. P., & He, Z. (2015). Enhancing management of fall-applied poultry litter with cover crop and subsurface band placement in no-till cotton. *Agronomy Journal*, 107, 449–458. <https://doi.org/10.2134/agronj14.0266>
- Tewolde, H., Sistani, K. R., & Adeli, A. (2013). Fall- and spring-applied poultry litter effectiveness as corn fertilizer in the mid-southern United States. *Agronomy Journal*, 105, 1743–1748. <https://doi.org/10.2134/agronj2013.0137>
- Tewolde, H., Sistani, K. R., & McLaughlin, M. R. (2016b). Residual effect of poultry litter applications on no-till cotton lint yield. *Agronomy Journal*, 108, 1405–1414. <https://doi.org/10.2134/agronj2016.01.0059>
- Tewolde, H., Sistani, K. R., Rowe, D. E., Adeli, A., & Johnson, J. R. (2007). Lint yield and fiber quality of cotton fertilized with broiler litter. *Agronomy Journal*, 99, 184–194. <https://doi.org/10.2134/agronj2006.0016>
- USDA-AMS. (2023). Daily spot cotton quotations. USDA-AMS. <https://www.ams.usda.gov/mnreports/cnddsq.pdf>
- USDA-NASS. (2025). Acreage. USDA-NASS. <https://release.nass.usda.gov/reports/acrg0625.pdf>
- USDA-NASS. (2025). Poultry: production and value 2024 summary. USDA-NASS. <https://esmis.nal.usda.gov/sites/default/release-files/m039k491c/ws85cd48j/q524mm00n/plva0425.pdf>

- Watts, D. B., Torbert, H. A., & Codling, E. E. (2019). Poultry production management on the buildup of nutrients in litter. *International Journal of Poultry Science*, 18, 445–553. <https://ijpsjournal.org/index.php/ijps/article/view/2532>
- Watts, D. B., Torbert, H. A., Prior, S. A., & Huluka, G. (2010). Long-term tillage and poultry litter impacts soil carbon and nitrogen mineralization and fertility. *Soil Science Society of America Journal*, 74, 1239–1247. <https://doi.org/10.2136/sssaj2008.0415>
- Watts, D. B., & Way, T. R. (2023). Influence of broiler litter band positioning on cotton growth and yield in a Blackland Prairie soil. *Agronomy Journal*, 115, 1489–1500. <https://doi.org/10.1002/agj2.21298>
- Zhang, D., Li, W., Xin, C., Tang, W., Eneji, A. E., & Dong, H. (2012). Lint yield and nitrogen use efficiency of field-grown cotton vary with soil salinity and nitrogen application rate. *Field Crops Research*, 138, 63–70. <https://doi.org/10.1016/j.fcr.2012.09.013>

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