

Sub-surface drip irrigation (SDI) fertigation for site-specific, precision management of cotton

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Subsurface drip irrigation study was installed at the Tennessee Valley Research and Extension Center (TVREC) in 2005 to evaluate four precision fertigation management scenarios. Approximately 7,500 feet of SDI tape and four positive displacement liquid fertilizer injectors were installed on five treatments with four replications in RCB design. The twenty treatment plots were made up of eight, 345-foot rows of cotton on 40-inch row spacing, with drip tape between every other row of cotton. The four fertigation treatments and one non-fertigated control are described in Table 1.

Table 1. Treatment description, fertigation management trials, 2008.

Treatment	Description
1. Control - drip irrigated, but all fertilizers are surface applied.	<i>Preplant</i> - N and K @ 60 pounds per acre. <i>Post-Plant N</i> (75lb/A) sidedressed at early square.
2. Timing 1 – with surface preplant	<i>Preplant</i> - 20 pounds of N and K (surface). <i>Drip</i> 40 pounds N,K –square to bloom (25 days) <i>Drip</i> 75 pounds N,K – bloom to 25 days
3. Drip timing 1 – no preplant	<i>Planting Drip</i> - 20 pounds N,K <i>Drip</i> 40 pounds N,K –square to bloom (25 days) <i>Drip</i> 75 pounds N,K – bloom to 25 days
4. Drip timing 2 – no preplant “spoon-fed”	<i>Planting Drip</i> - 20 pounds N,K <i>Drip</i> 40 pounds N,K square to bloom (25 days) <i>Drip</i> 75 pounds N,K – bloom to 40 days
5. Timing 2 – with surface preplant	<i>Preplant</i> - 40 pounds of N and K (surface). <i>Drip</i> 95 pounds N,K –square through bloom (50 days)

All treatments received 135 pounds per acre of nitrogen and potassium (K₂O), 20 pounds per acre of sulfur, and 1.0 pound per acre of boron. Phosphorus fertilizer was surface-applied to maintain P at high soil test levels. Drip fertilizer was 8-0-8-1.2S-0.06B made using 32% liquid N, potassium thiosulfate, fertilizer grade KCL, solubor, and water.

Yield results for 2008, are shown in Figure 1. Total seasonal rainfall at TVREC during June-August period for 2008 was 11.27”, which was near the normal average of 11.50”. Thus, seed cotton yields for this season were higher than in 2006 and 2007. The response to fertilizer treatments in 2008 is similar to 2007. In 2008, the 100% fertigated treatments (3 & 4) produced significantly lower ($\alpha= 0.1$) yields than treatment 1 (100% surface-applied) and treatment 5 (30% surface + 70% drip) and they gave comparatively lower yield than treatment 2 (15% surface + 85% drip). The non-fertigated control treatment and the fertigated treatments that received surface-applied, preplant nitrogen and potassium (K₂O) responded much better in 2008, possibly due to sufficient rainfall and better downward movement of surface-applied fertilizer. However, higher rains may have also resulted in leaching fertigated nutrients farther out of the root zone. This may explain observed plant yellowing and reduced vegetative growth in treatments 3 and 4 during the season, although soil compaction impeding root growth to fertigated nutrients cannot be ruled out. Treatment 1 is statistically the best yielding treatment in 2007 and 2008 whereas treatments 3 and 4 are the lowest yielding.

Cotton yield (bales/acre), lint quality parameters, and leaf nutrient analyses are presented in Table 2. None of the quality parameters were significantly affected by different fertilizer treatments except for lint length. Lint length in the 100% fertigated treatments (4) was significantly higher ($\alpha=0.1$) than the fertigated treatments that received surface-applied, preplant nitrogen (N) and potassium (K_2O).

Plant uptake for N and K was significantly higher ($\alpha=0.1$) in the surface-applied control treatment (treatment 1) than all fertigated treatments, with or without surface application. Higher seasonal rainfall in 2008 may have assisted delivery of surface-applied, preplant N and K. Phosphorus, Ca, and Mg contents were not significantly affected by any treatment.

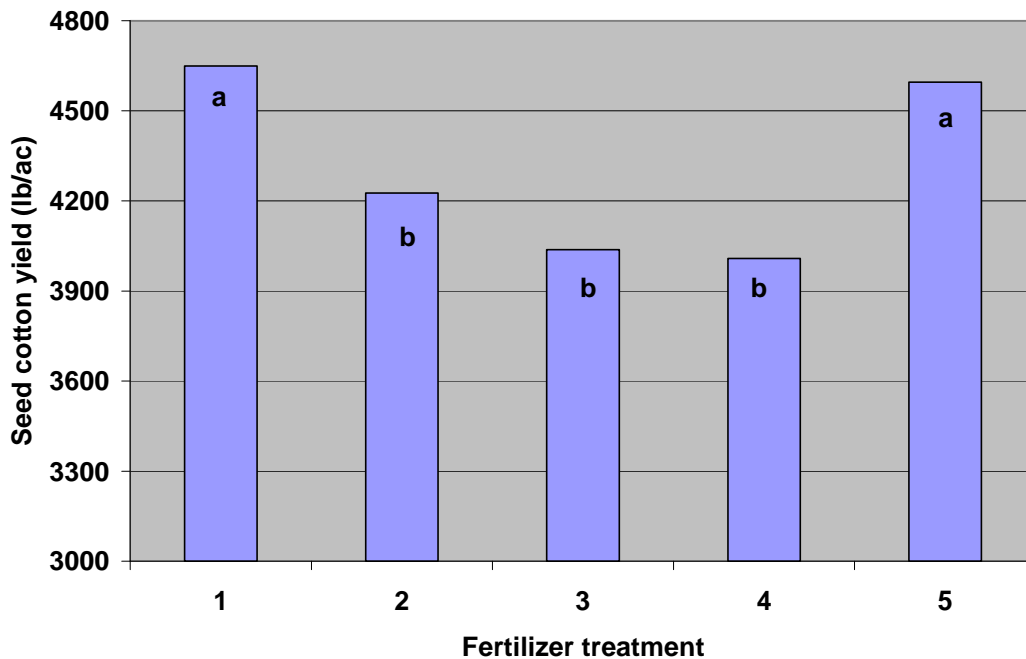


Figure 1. Seed cotton yield, lb/ac, drip tier fertigation management study, Belle Mina, AL, 2008. N=4. Turnout = 40%. Different letters indicate significant difference ($\alpha=0.1$)

Table 2. Lint yield and quality analysis, cotton fertigation management trials, 2008.

trt	bales/ac	Mic	Length	Strength	Uniformity	N%	P%	K%	Ca%	Mg%
1	3.9 ^a	4.62 ^a	1.10 ^b	27.2 ^a	84.2 ^a	4.32 ^a	0.28 ^a	1.20 ^a	2.27 ^a	0.26 ^a
2	3.5 ^b	4.78 ^a	1.07 ^c	27.2 ^a	83.2 ^a	3.36 ^c	0.27 ^a	1.09 ^b	2.22 ^a	0.26 ^a
3	3.4 ^b	4.75 ^a	1.11 ^{ab}	28.5 ^a	84.1 ^a	3.24 ^c	0.28 ^a	1.13 ^b	2.26 ^a	0.25 ^a
4	3.3 ^b	4.58 ^a	1.13 ^a	28.4 ^a	84.5 ^a	3.35 ^c	0.30 ^a	1.14 ^b	2.36 ^a	0.26 ^a
5	3.8 ^a	4.65 ^a	1.09 ^{bc}	28.9 ^a	84.0 ^a	3.57 ^b	0.28 ^a	1.13 ^b	2.28 ^a	0.26 ^a

1. Surface applied N-P-K with drip irrigation (control). 2. Preplant 20# N-K surface with 2 N-K drip timings. 3. 20# N-K drip at planting with 2 N-K drip timings (to 25 days after bloom). 4. 20# N-K at planting with 2 N-K drip timings (to 40 days after bloom). 5. Preplant 40# N-K surface with 1 N-K drip timing (square through bloom). Different subscripts denote statistical difference ($\alpha=0.1$). N=4. Turnout = 40%.