

Evaluation of the Effects of AlgEternal's Agtivate Soil Amendment on Rice Growth, Yield and Milling Quality

2017

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MATERIALS AND METHODS

A field trial analyzing the use of AlgEternal's Agtivate soil amendment product was conducted during the 2017 growing season at the David R. Wintermann Texas A&M AgriLife Research and Extension Center located in Eagle Lake, TX. This was the 3rd year of trials analyzing the product. The 2017 trial utilized the same experimental design as the 2016 trial to analyze the effects of Agtivate on rice growth and yield in conjunction with reduced rates of Nitrogen fertilizer inputs. The soil was a loam with 47% sand, 30% silt, 23% clay and pH of 5.7 on average consisting predominantly of the Nada soil classification series. (**Appendix A**) The area used to conduct the trial was in a rice-fallow rotation where rice is seeded every three years. Soil was disked to reduce vegetative biomass during the winter preceding establishment of the trial. Prior to crop seeding in the spring, the seedbed was cultivated again and the soil surface was graded to guarantee adequate field slope.

The trial was conducted as a randomized complete block design with a factorial arrangement. All Agtivate treatment applications were made pre-plant (PRE) at a rate of 11.64 ounces of product per acre. Nitrogen (N) fertilizer treatment applications were made using a 4 way split method at pre-plant (PRE), pre-flood (PF), panicle differentiation (PD) and boot crop growth stage timings using pounds N per acre rates. PRE and PF N applications were made using urea (46-0-0) while PD and boot N applications were made using ammonium sulfate (21-0-0). Treatments included in the trial were (1) non-treated check [0 Agtivate / 0 N], (2) standard nitrogen management [0 Agtivate / 185N (50, 60, 37.5, 37.5)], (3) Agtivate alone [11.64 Agtivate / 0N], (4) Agtivate + 25% nitrogen [11.64 Agtivate / 46N (13, 15, 9, 9)], (5) Agtivate + 50% nitrogen [11.64 Agtivate / 92.5N (25.5, 30, 18.5, 18.5)] and (6) Agtivate + 75% nitrogen [11.64 Agtivate / 139N (38, 47, 27, 27)]. All treatments were replicated 4 times. (**Appendix B**)

Agtivate treatment applications were made on April 3, 2017 using a hand held sprayer and PRE N applications were also made by hand on April 3, 2017. Additionally, 50 pounds per acre of both phosphorus and potassium in the form of 0-25-25 were applied PRE on April 3, 2017. All PRE applications were incorporated in the soil. The trial was drill-seeded on April 5, 2017 using the cultivar 'Presidio' at the rate of 70 pounds per acre. Emergence of rice occurred 8 days after seeding (DAS) on April 13, 2017. Plots were formed by 6 rows spaced 7.5 in. between rows (3.75 ft. wide) and measuring 16 ft. long. Plots were planted on 8 ft. centers. A weed control maintenance application consisting of 13 oz pr/ac Command 3ME® (*Clomazone*) + 96 oz pr/ac Stam M4® (*Propanil*) + 48 oz pr/ac Bolero 8EC® (*Thiobencarb*) + 1 oz pr/ac Permit® (*Halosulfuron*) was applied on April 24, 2017. PF nitrogen fertilizer applications were made on May 10, 2017. The trial was flushed (submerged and subsequently drained) on April 28, 2017 and May 4, 2017 prior to permanent flood establishment. The permanent flood was established 28 days after rice emergence (DAE) on May 11, 2017. PD nitrogen fertilizer applications were made on June 2, 2017 and boot nitrogen fertilizer applications were made on June 19, 2017. Plant height was measured for each treatment prior to harvest. Two plants were measured in each plot above ground to the tip of the flag leaf. These measurements were used to calculate the average plant height for each treatment. (**Appendix B**)

Draining of the permanent flood from the field began on July 14, 2017 and harvesting of the trial occurred on July 21, 2017. Four inside rows of each plot were harvested using a mechanical harvester (Mitsubishi VM221KC, Mitsubishi Agricultural Machinery Co., Higashiizumo, Shimane, Japan) when grain moisture was as close to 20% as field conditions allowed. Grain weight and moisture content was collected using an electronic scale (Mettler-

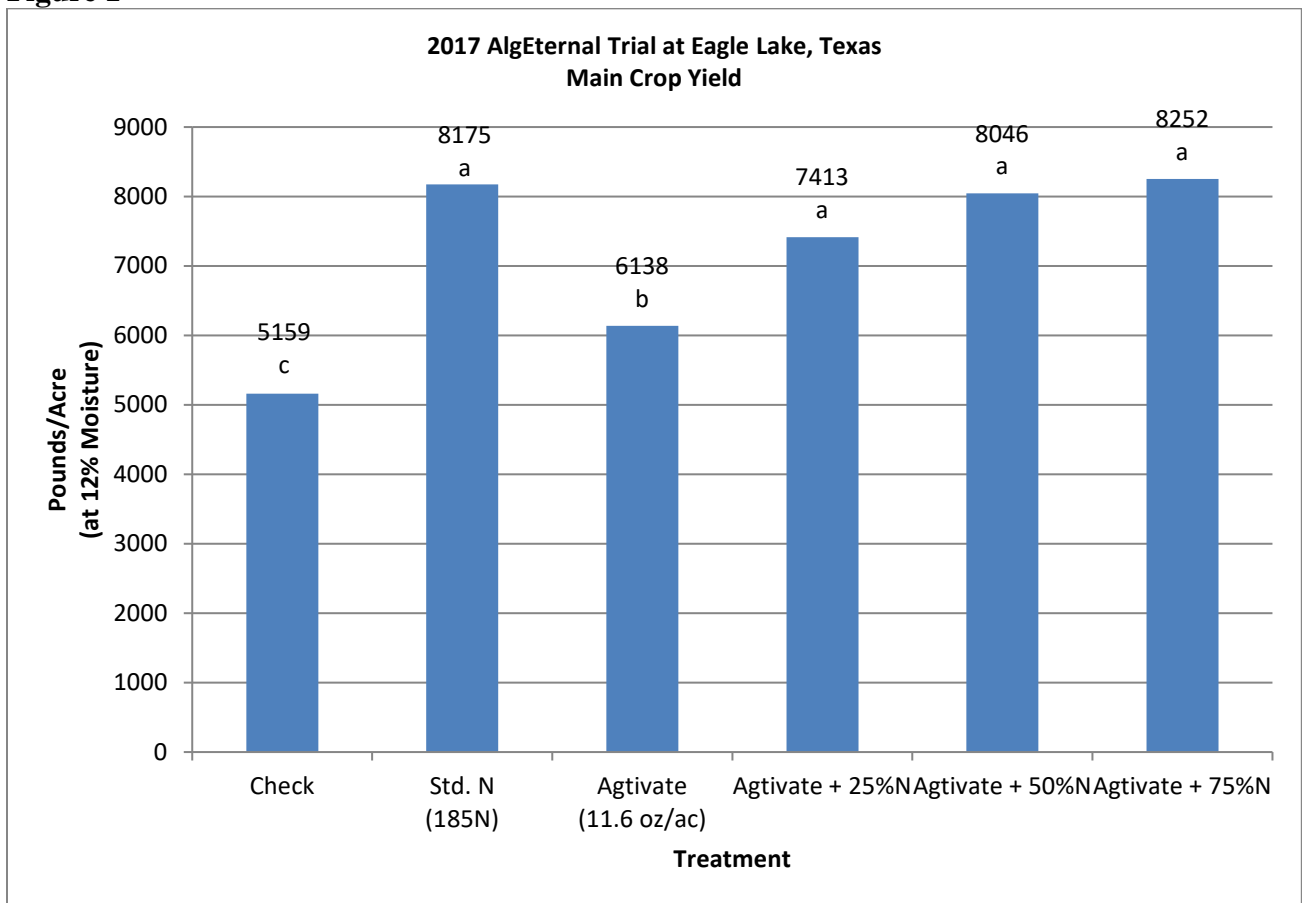
Toledo BBA 422-35SM, Mettler-Toledo, L.L.C., Columbus, OH) and moisture analyzer (DICKY-john GAC2100b, DICKY-john Co., Auburn, IL). Grain weight was adjusted to 12% moisture. Subsequently, a sub-sample was removed, dried and used to determine milling yield. Dried samples were processed using a rice-milling machine (PAZ/1DTA, Zaccaria Equipment for Cereals, Lemeira-SP-Brasil). All statistical analysis was conducted using the SAS software package (version 9.4, SAS Institute Inc., Car, NC). Analysis of variance (ANOVA) was performed on data with the general linear model procedure. Means for treatments were compared using Fisher's protected least significant difference at $P = 0.05$.



RESULTS AND DISCUSSION

At harvest average grain moisture was 22%. Average yield ranged from 5,159 lb/ac in the non-treated check to 8,252 lb/ac in the Agtivate + 75% N treatment. Average yield for the Agtivate alone treatment was 6,138 lb/ac, an increase of 997 lb/ac over the non-treated check. All combinations of Agtivate + Nitrogen were within 762 lb/ac of the average yield for the standard nitrogen management treatment, with the Agtivate + 75% N treatment yielding 77 lb/ac more on average. Yield for all treatments consisting of reduced nitrogen rates in conjunction with Agtivate were statistically equal to the standard nitrogen treatment. Additionally, the yield for the Agtivate alone treatment was statistically higher than the untreated check. **(Fig. 1).**

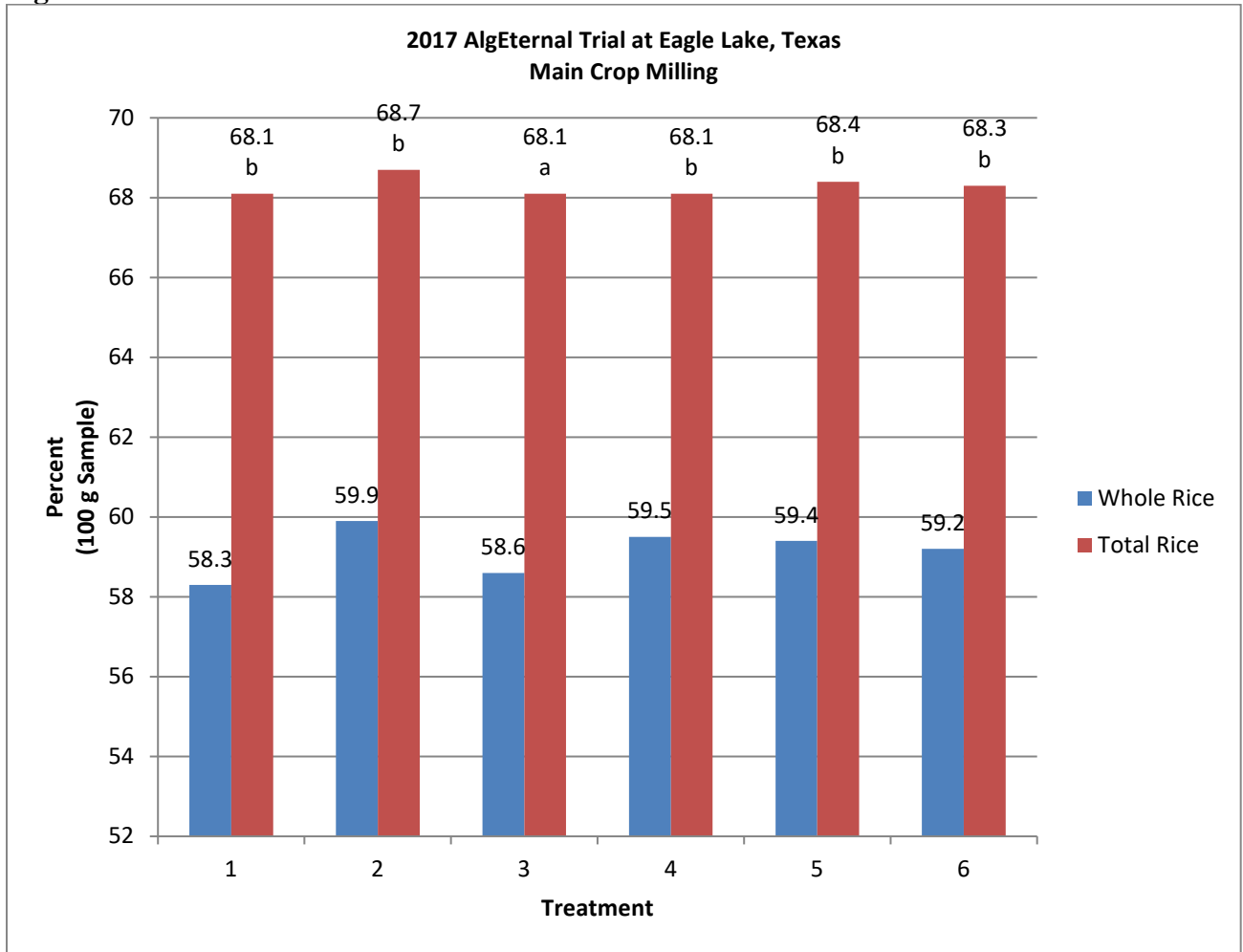
Figure 1



*Means with the same letter are not significantly different ($P = 0.05$)
According to Fisher's protected least significant difference (LSD) test.

Average grain milling yield ranged from 68.1%/58.3% (Total Grain/Whole Grain) in the non-treated check to 68.7%/59.9% in the standard nitrogen treatment. Grain milling yields were 68.1%/58.6% for the Agtivate alone treatment. Whole grain milling yields were typical for all treatments (Fig. 2).

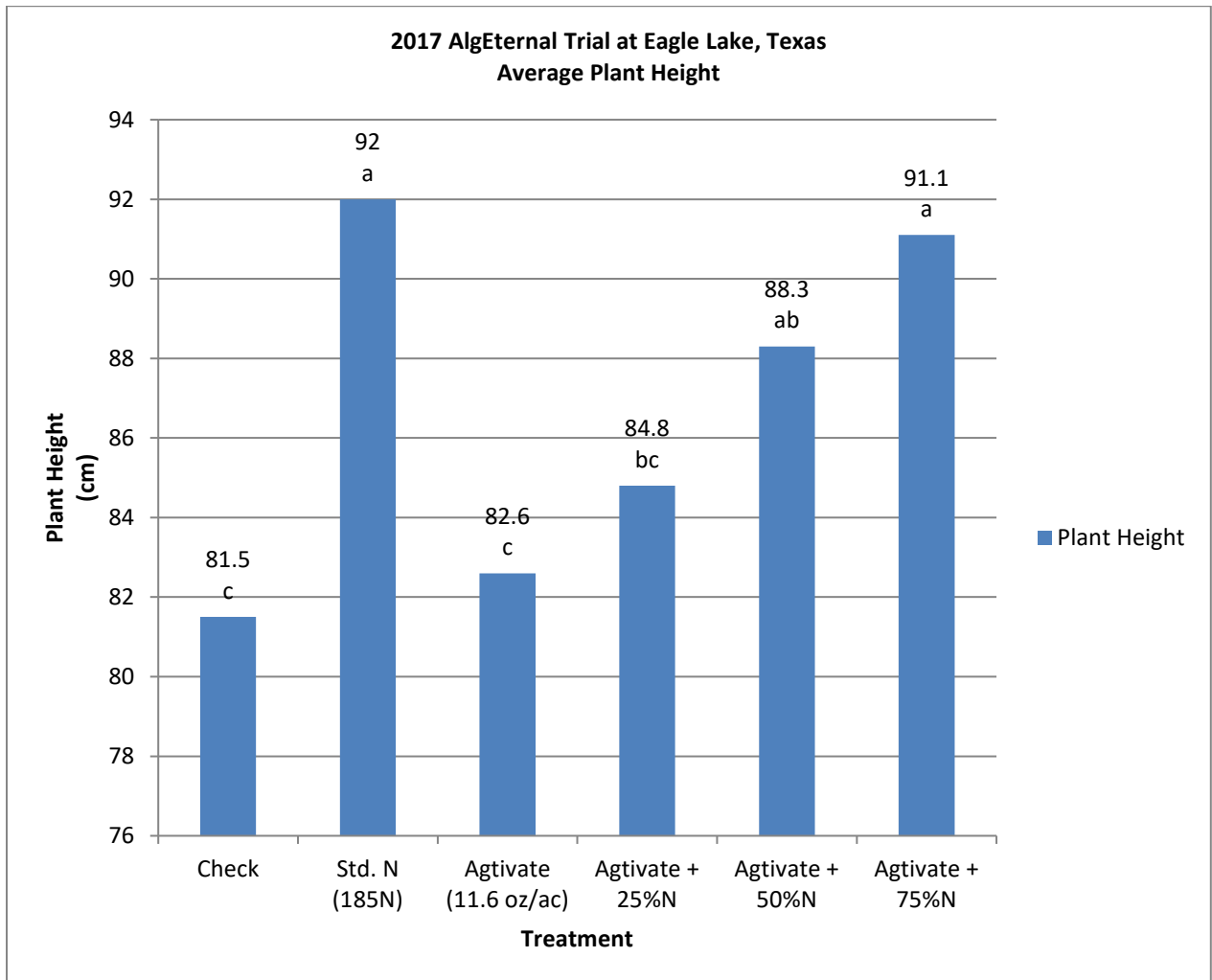
Figure 2



*Means with the same letter are not significantly different ($P = 0.05$) According to Fisher's protected least significant difference (LSD) test.

Plant height can be a good indicator of plant health and yield potential. Plant height was measured for each treatment prior to harvest. As expected, the treatments receiving nitrogen were taller than both the non-treated and the Agtivate alone treatments. The standard nitrogen treated plants were 9.4 cm taller than the Agtivate only treated plants and 10.5 cm taller than the non-treated plants at maturity. (Fig. 3).

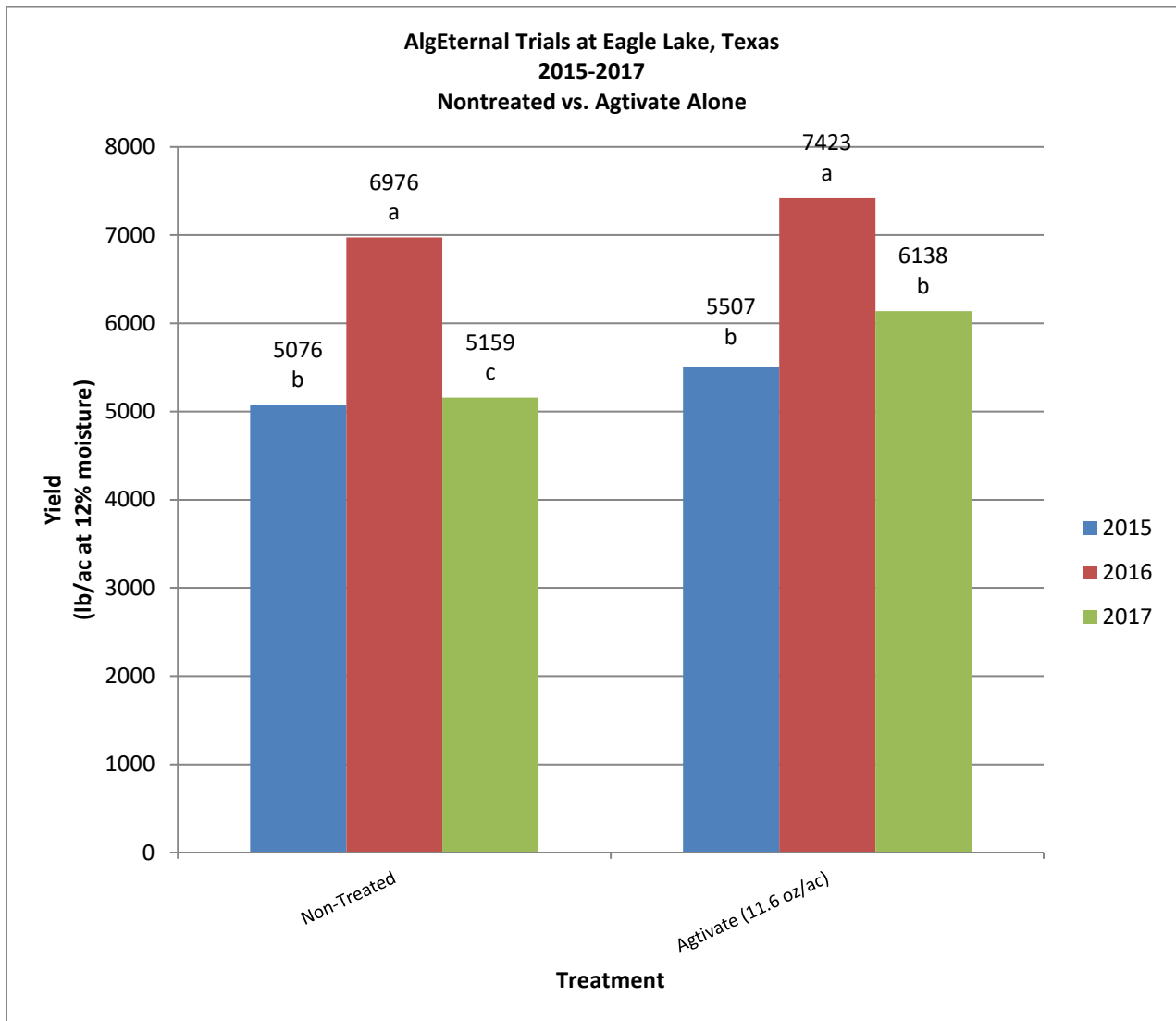
Figure 3



*Means with the same letter are not significantly different (P = 0.05) According to Fisher's protected least significant difference (LSD) test.

In 2017, plots treated with Agtivate alone yielded 979 lb/ac more on average than the non-treated check. In 2016 and 2015, plots treated with Agtivate alone yielded 447 lb/ac and 431 lb/ac more on average than the non-treated check respectively. Three consecutive years of data suggest that application of Agtivate could increase yield by more than 400 lb/ac compared to rice crops receiving 0 nitrogen fertilizer inputs. Yield differences between the non-treated check and the Agtivate alone treatment were not statistically different in 2015 or 2016, but in the 2017 trial they were. (Fig. 4).

Figure 4



*Means with the same letter are not significantly different ($P = 0.05$) According to Fisher's protected least significant difference (LSD) test.

Additional detailed information, including individual plot data and statistical summary can be found in the appendices.

SUGGESTION FOR FUTURE RESEARCH

Data from three years of trials suggest that the application of Agtivate may contribute to increased yields above that of rice treated with no nitrogen. However it does not appear that applications of Agtivate alone are a viable alternative to nitrogen applications in rice. Data from the 2016 and 2017 trials suggest that the application of Agtivate in conjunction with significantly reduced rates of nitrogen fertilizer inputs may be a viable and cost reducing option as a rice fertility program. Continued research into the use of Agtivate in conjunction with reduced nitrogen rates needs to be conducted to see if these results are repeatable and hold true. Additionally plant health and insect assessments should be conducted to evaluate if Agtivate shows any effects in these areas. **Table A** outlines potential treatments that could provide useful data and indicators toward that goal. Including a second block in the trial that has no Agtivate applications should help to provide answers as to whether or not movement of Agtivate in the soil is affecting non-target treatments.

Table A

Block 1 - Agtivate Treatments

Trt. No.	Trt. Desc.	Fertility Inputs				
		PRE	PF	PD	Boot	Total
1	Check					
2	Agtivate	11.64 A	0	0	0	11.64 A
3	Agtivate+25%N	11.64 A + 13 N	15 N	9 N	9 N	11.64 A + 46 N
4	Agtivate+50%N	11.64 A + 25.5 N	30 N	18.5 N	18.5 N	11.64 A + 92.5 N
5	Agtivate+75%N	11.64 A + 38 N	47 N	27 N	27 N	11.64 A + 139 N
6	Agtivate+100%N	11.64 A + 50 N	60 N	37.5 N	37.5 N	11.64 A + 185 N

Block 2 - Nitrogen Only Treatments

Trt. No.	Trt. Desc.	Fertility Inputs				
		PRE	PF	PD	Boot	Total
7	Check	0	0	0	0	0
8	Standard N	50 N	60 N	37.5 N	37.5 N	185 N
9	25% N	13 N	15 N	9 N	9 N	46
10	50% N	25.5 N	30 N	18.5 N	18.5 N	92.5 N
11	75% N	38 N	47 N	27 N	27 N	139 N

Appendix A

Texas A&M AgriLife Research

Eagle Lake, Texas

F16-103

Study Area Soil Analysis

The study area soil was a loam with 47% sand, 30% silt, 23% clay and pH of 5.7 on average consisting predominantly of the Nada soil classification series.

Nada FSL: Fine, Smectitic, Thermic Typic Albaqualfs

Trial Soil Analysis Reports

2017 AlgEternal Trial at Eagle Lake, Texas

Trial Soil Analysis Reports

	Pre Trial	Post Trial Non-Treated	Post Trial Standard N Mgt.	Post Trial Agtivate	Post Trial Agtivate +25%N	Post Trial Agtivate +50%N	Post Trial Agtivate +75%N
pH	5.7	6.0	5.5	5.7	5.7	5.3	5.1
Conductivity (umho/cm)	118	158	159	162	159	182	185
Nitrate-N (ppm)	3	1	2	1	1	2	2
Phosphorus (ppm)	25	15	11	17	20	31	21
Potassium (ppm)	103	32	27	31	32	30	35
Calcium (ppm)	1203	1373	1190	1296	1332	1246	1202
Magnesium (ppm)	170	171	157	177	180	154	157
Sulfur (ppm)	2	10	15	15	15	23	18
Sodium (ppm)	347	47	46	47	49	47	44
Sand (%)	47	49	51	49	43	47	51
Silt (%)	30	22	32	32	36	34	30
Clay (%)	23	29	17	19	21	19	19
Textural Class	Loam	Sandy Clay Loam	Loam	Loam	Loam	Loam	Loam
Organic Matter (%)	1.94	0.71	0.74	0.93	1.01	1.11	0.92

Appendix B

Texas A&M AgriLife Research

Eagle Lake, Texas

F16-103

Study Name: AlgEternal Fertility Evaluation

Rice Variety: Presidio (planted at 70 lb/ac)

Plot Size: 3.75 X 16 feet

Planted: 5-April

Emergence: 13-April

MC Flood: 11-May

MC Drain: 14-July

MC Harvest: 21-July

Herbicide: 24-April: 13 oz/ac Command 3ME + 96 oz/ac Stam M4 + 48 oz/ac Bolero 8EC + 1 oz/ac Permit

Fertilizer: PrePlant N: 3-April PrePlant P&K: 3-April

PreFlood N: 10-May

PD N: 2-June

Boot N: 19-June

Agtivate: 3-April

2017 AlgEternal Trial at Eagle Lake, Texas

Treatment List

Trt. No.	Treatment	Fertility Inputs				
		PP	PF	PD	Boot	Total
1	Non-Treated Check	0	0	0	0	0
2	Standard N Management	50N	60N	37.5N	37.5N	185N
3	Agtivate	11.64A	0	0	0	11.64A
4	Agtivate+25%N	11.64A + 13N	15N	9N	9N	11.64A + 46N
5	Agtivate+50%N	11.64A + 25.5N	30N	18.5N	18.5N	11.64A + 92.5N
6	Agtivate+75%N	11.64A + 38N	47N	27N	27N	11.64A + 139N

2017 AlgEternal Trial at Eagle Lake, Texas

Plot Plan

Plot	Treat.	Plot	Treat.	Plot	Treat.	Plot	Treat.
101	1	201	2	301	5	401	5
102	2	202	6	302	3	402	1
103	3	203	5	303	1	403	6
104	4	204	3	304	4	404	2
105	5	205	4	305	6	405	3
106	6	206	1	306	2	406	4

Appendix C

Yield and Milling Data for AlgEternal Agtivate Trial at Eagle Lake, Texas 2017

Plot	Trt. Desc.	Treatment	Rep	Planted	Emergence	25% Heading	Height	Harvest	Yield@12%	Moisture	Total	Whole
101	N-T	1	1	95	103	172	80.5	202	4552	21.0	68.3	58.3
206	N-T	1	2	95	103	172	84.5	202	5530	21.3	68.2	58.4
303	N-T	1	3	95	103	172	82.5	202	5512	21.2	68.1	58.0
402	N-T	1	4	95	103	172	78.5	202	5041	20.7	67.8	58.5
102	Std N	2	1	95	103	175	88.5	202	8920	24.0	69.3	61.1
201	Std N	2	2	95	103	175	95.0	202	8014	25.3	69.1	59.4
306	Std N	2	3	95	103	176	95.0	202	8055	23.8	68.5	59.8
404	Std N	2	4	95	103	176	89.5	202	7711	24.8	68.1	59.2
103	Agtivate	3	1	95	103	173	80.5	202	5476	20.6	68.3	58.1
204	Agtivate	3	2	95	103	173	85.5	202	5849	21.0	68.2	58.9
302	Agtivate	3	3	95	103	173	80.5	202	5869	19.9	68.3	58.8
405	Agtivate	3	4	95	103	173	84.0	202	7357	21.9	67.5	58.6
104	A+25%N	4	1	95	103	173	84.5	202	7514	20.6	68.6	60.4
205	A+25%N	4	2	95	103	173	88.0	202	8026	21.4	68.3	59.9
304	A+25%N	4	3	95	103	173	79.0	202	7576	21.4	68.0	59.3
406	A+25%N	4	4	95	103	173	87.5	202	6537	20.8	67.4	58.3
105	A+50%N	5	1	95	103	174	90.5	202	8044	22.3	68.2	57.4
203	A+50%N	5	2	95	103	174	89.0	202	8217	22.7	68.8	59.7
301	A+50%N	5	3	95	103	174	91.5	202	7599	22.9	68.6	60.2
401	A+50%N	5	4	95	103	174	82.0	202	8324	21.7	67.9	60.3
106	A+75%N	6	1	95	103	174	93.0	202	8313	22.4	68.4	57.9
202	A+75%N	6	2	95	103	174	92.5	202	7741	23.7	68.8	59.3
305	A+75%N	6	3	95	103	174	86.5	202	7884	23.2	68.3	60.2
403	A+75%N	6	4	95	103	174	92.5	202	9071	22.5	67.9	59.4

2017 AlgEternal Study @ Eagle Lake (Averages)

Treat.	Trt. Desc.	Yield@12%	Hvst. Moist.	Milling Total	Milling Whole
1	N-T	5159	21.1	68.1	58.3
2	Std N	8175	24.5	68.7	59.9
3	Agtivate	6138	20.9	68.1	58.6
4	A+25%N	7413	21.1	68.1	59.5
5	A+50%N	8046	22.4	68.4	59.4
6	A+75%N	8252	23.0	68.3	59.2

Appendix D

Statistical Summary Table for 2017 AlgEternal Activate Trial at Eagle Lake, Texas

Treatment	Treatment Description	Average 15% Heading	Average Plant Height	Average Yield	Average Total Grn.	Average Whole Grn.
1	0 N + 0 Alg	172 d	81.5 c	5159 c	68.1 b	58.3
2	185 N (50-60-37.5-37.5) + 0 Alg.	176 a	92 a	8175 a	68.7 b	59.9
3	0 N + 11.64 oz Alg/ac (PP)	173 c	82.6 c	6138 b	68.1 a	58.6
4	46 N (13-15-9-9) + 11.64 oz Alg/ac (PP)	173 c	84.8 bc	7413 a	68.1 b	59.5
5	92.5 N (25.5-30-18.5-18.5) + 11.64 oz Alg/ac (PP)	174 b	88.3 ab	8046 a	68.4 b	59.4
6	139 N (38-47-27-27) + 11.64 oz Alg/ac (PP)	174 b	91.1 a	8252 a	68.3 b	59.2
P		< 0.0001	0.0014	<0.0001	0.0046	0.2046
LSD		0.4	5.0	942	0.3	NS

^y Means within a column with the same letter are not significantly different ($P = 0.05$) according to Fisher's protected LSD test.

^y P values ≤ 0.05 indicate significant differences exist among treatments.

^u NS = Not significant at $P = 0.05$ based on Fisher's protected LSD test.

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