Trial Report: FloBond DI 2010 Fall 2017 Bell Pepper

Conducted by:
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Production
Location: Tifton, GA
Variety: 'Aristotle' (Seminis Seeds) obtained from Lewis Taylor Farms.
Planting Date: 15 Aug.
Plant Spacing: 6' centers white TIF plastic mulch, with double rows of 12-inch in row spacing (14,520 per acre pop.).
Plot size: 80-foot plots (160 plants plants per plot) with four replications of each of the two treatments (control and FloBond 2010)
Soil Characteristics: 90.4% sand, 2.8% clay, 6.8% silt, 0.4% organic matter, pH 7.1
Fumigation: Chloripicrin 100% applied when plastic laid.
Fertility: 500 lbs/acre 10-10-10 preplant broadcast with approximately 16 lb/N/week applied via drip using 4-0-8 liquid fertilizer for a total in season 242 lbs N total.
Irrigation: Drip irrigation 2x per day for 60 minutes per application initially and later during the season at 1x per day for 60 minutes. Long irrigations were conducted at planting to reduce heat stress and after hurricane Irma.
Herbicide: A row middle application of treflan, dual magnum, and valor was applied to row middles.
Pest Control: Twice weekly insecticide sprays for whiteflies and broad mites (T/F) and weekly (F) fungicide sprays according to UGA recommendations. Venom was applied at planting through the drip for control of whitely. Whitefly controls were typically a Group 4 insecticide (Sivanto/Movento) alternated with a Group 28 insecticide (Coragen, Verimark). Sprays for pepper weevil were conducted beginning in late September and included applications of Vydate (Oxamyl) insecticide at the highest labeled rate (4 pts/acre) 2x per week for 3 weeks and then 1x per week.
Treatments applied: There were 7 applications of the product during the season. At planting (2.5 qt/acre) and on 21 and 7 Sept. (2.0 qt/acre each) and on 22 Sept. and 3, 10 and 17 Oct. (2.5 qt/acre) Drip lines were charged fully, product injected and drip allowed to run for 30 minutes to flush lines.
Plant Vigor Ratings: 17 Oct and 17 Nov. (1-5 scale) 1= no growth, 5= extremely vigorous. A harvest was conducted on 1 Nov. but yields were not appropriate for commercial production due to pepper weevil damage causing fruit to abort/drop. No yields will be reported.
Plant Nutrient Content: Leaf samples (newest fully expanded leaves) 15-20 leaves per plot, were taken on 17 Nov. and analyzed for complete nutrient content by Waters Ag. Lab (Camilla, GA)
Soil Moisture: Decagon EM50G data logger was placed in the field with 10HS soil moisture sensors (Decagon). Sensors were placed in the planted row equidistant from plants at depths of 4-6 inches and 8 inches in treated and untreated plots. The treated plot also received a probe at a depth of 12-inches in the planted row.
Statistics: The GLM procedure and Fisher's least significance test ($P<0.05$) conducted on data using SAS version 9.3.

Results: Table 1 and 2 and Figures 1 and 2 contain results (below).

Vigor and Nutrient Content. Initially there were no observable differences between treatments. At planting, high air temperatures were 92 ^{o}F and they remained above 90 ^{o}F for 12 days after planting. This placed a considerable stress on plants during the time of the initial two treatments and there were no notable differences between control and treated plants at that time. It should be noted that plants were excessively irrigated during this time period to ensure survival. After this period of high temperatures, plants were subjected to severe weather conditions (Hurricand Irma), which took place from 9-11 September. After this time, it was noted that the first replicate of the control plants was severely damaged due to water and wind damage. Therefore the first replicate of treated and non-treated (control) plants were removed from further analysis. After the plants recovered from the hurricane, four additional treatments were applied. By 3 October, there were differences that were observable between treated and untreated plots. By mid October (final treatment) vigor ratings were taken of plants (Table 1). During the first vigor rating the treated plants were significantly more vigorous than control plants. The second vigor rating taken on 17 November showed that the treated plants had a higher numeric value for vigor, but were not significantly different from the control plants. The season average suggests the treated plants were significantly more vigorous than non-treated plants.

Table 1. Vigor date from FloBond treated peppers.

	Vigor		
Treatment	17 Oct.	17 Nov.	Avg.
Control	2.83 b	3.33 a	3.08 b
Flobond 2010	3.83 a	4.17 a	4.00 a

[z]Values within the same column followed by the same letter(s) are not significantly different according to Fisher's Least Significant Difference Test (P<0.05)

Results of the nutrient analysis of the plants were somewhat unexpected though reasonable given the growth of the plants. There were no significant differences in nutrient concentrations between treated and untreated plants, with the exception of foliar Zn concentrations (Table 2). However, for most nutrients (N, P, K, Ca, B, and Mn) the control plants had higher numerical values than treated plants. This was not expected, particularly with regard to nutrients such as potassium (K), which were nearly 1% high in the control plants than the treated plants. However, it should be noted that leaf tissue analysis measures nutrient concentration, and not total content or uptake. The significantly higher vigor of the treated plants indicated that there may have been a dilution-effect occurring for nutrient content in leaves. It is not uncommon for larger more vigorously growing plants to have a lower concentration of nutrients, only to have a high total content of nutrients due to greater

biomass. This is likely what occurred in the treated plants as they visually appeared more vigorous and robust. All nutrient levels in leaves, regardless of treatment, were adequate to high for bell pepper plants according to Bryson et al., (2014). Total nutrient removal may be a better measurement of the effectiveness of this product.

Table 2. Nutrient concentrations of FloBond treated peppers.

	(%)						(PPM)				
	N	P	K	Mg	Ca	S	B	Zn	Mn	Fe	Cu
Control	4.45 a[z]	0.31 a	4.84 a	0.35 a	2.16 a	0.44 a	50 a	127 a	446 a	87 a	397 a
FloBond	4.40 a	0.28 a	3.90 a	0.31 a	2.02 a	0.47 a	45 a	92 b	431 a	96 a	428 a

[z]Values within the same column followed by the same letter(s) are not significantly different according to Fisher's Least Significant Difference Test (P<0.05)

Soil Moisture. Soil moisture sensors were not placed in the field due to availability until 5 Oct. Early measurements taken with a hand-held moisture meter at a depth of approximately 8-inches at several locations in the bed did show large numerical differences, but not statistically significant differences between treated and control plots. Taken on 3 Sept., the treated plots averaged 16.5% volumetric water content (VWC), while control plots averaged 11.8% VWC. Figure 1 reports the average daily soil VWC from the day of deployment until the termination of the trial. The 4-6-inch deep probes in the control plots had consistently more soil moisture than the comparable probe depths in the treated plots. Although somewhat unexpected, the treated plots did have significantly more vigorous plants. Research by the author of this report has shown that nearly 60% of pepper roots for plants grown on raised beds with plastic mulch are in the top 6-inches of soil (unpublished data). Therefore, since both treatments were watered equally it is not surprising that the more vigorous plants removed more moisture from the top several inches of soil. In contrast, the treated plots had a higher soil VWC when measured at an 8-inch depth compared to the control plots. Recall that the probes were placed in the planted row (approximately 8-9 inches from drip tubing). This suggests that water movement outward and down throughout the bed may be improved with the Flobond. Figure 2 shows the soil VWC for a one week period after putting out probes – this figure allows one to see the hourly response to soil moisture. Every day there are two peaks for moisture corresponding to the two irrigation times (morning and late afternoon) that occurred early in the season (Figure 2). What is most notable about the soil VWC response in the control and the treated plots is the shape of the curve after irrigation. In all treated locations there is a sudden increase in soil VWC corresponding to irrigation (red, purple, and black lines). However the control plots have a flatter response to irrigation (blue and green lines). Again, recall that the soil moisture sensors are 8-9 inches from the drip tubing. Results suggest that water moves more quickly out to the planted row (edges) of the beds in the treated plots versus the controls. Figure 3 shows the soil volumetric water content at the rooted depth (8-inches) in control and treated plots. Both plots were irrigated identically, yet the treated plot had consistently higher moisture levels in the root zone of the pepers. Figure 4 was taken roughly two weeks post-transplant and shows more uniform water movement throughout the treated beds (right) compared to controls (left).

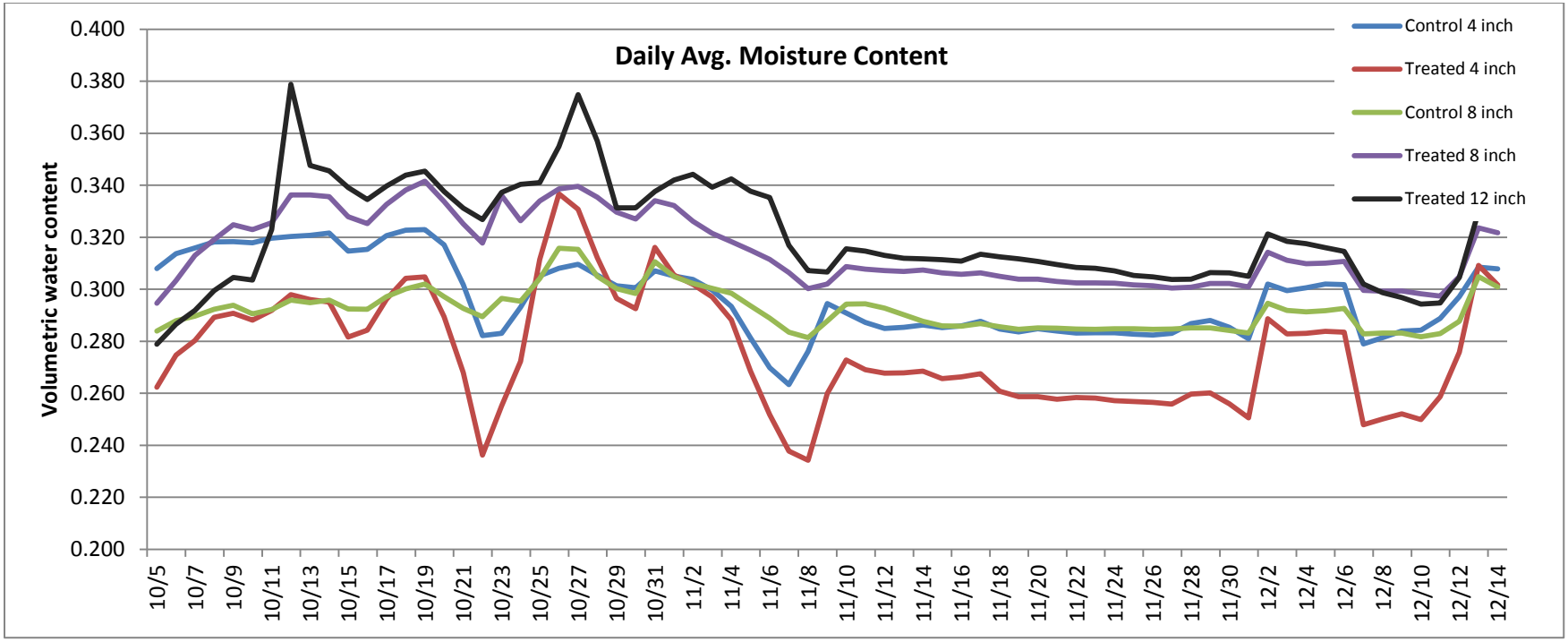

Figure 1. Season daily average volumetric water content for the trial.

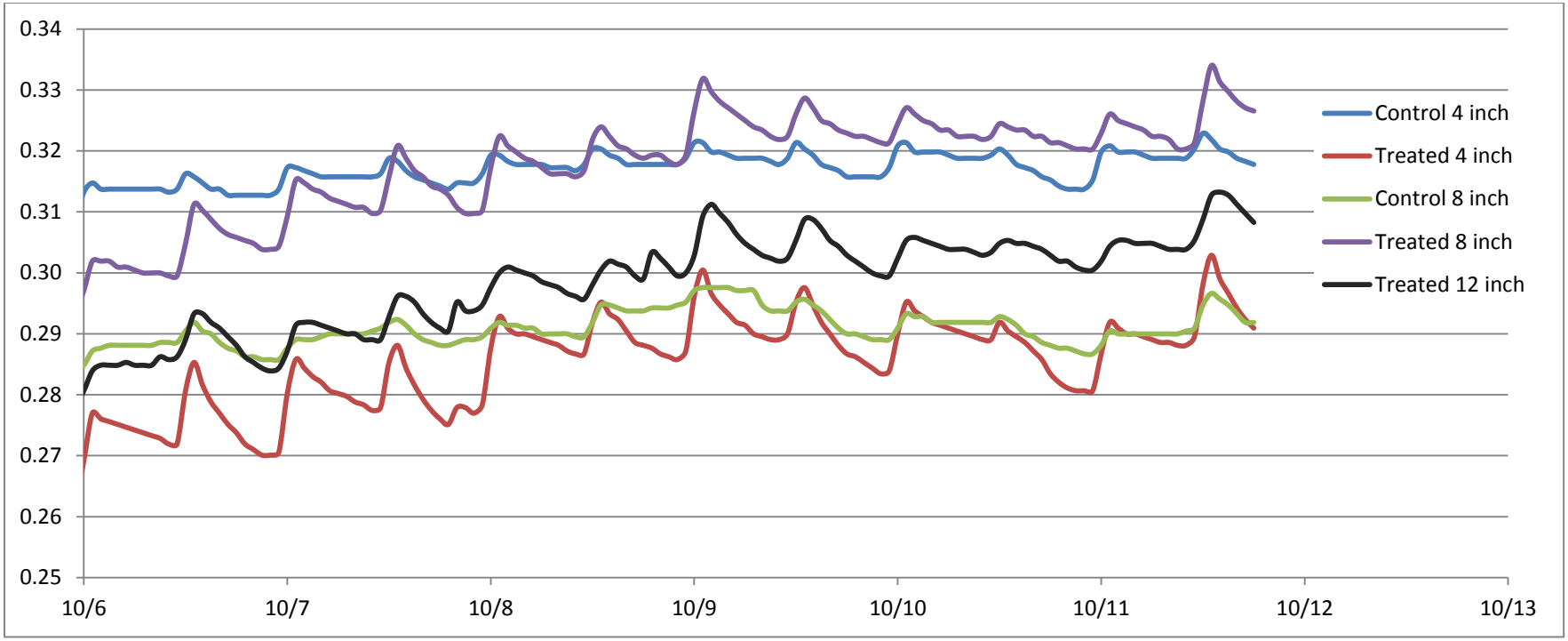

Figure 2. Hourly volumetric water content for one week after deployment.

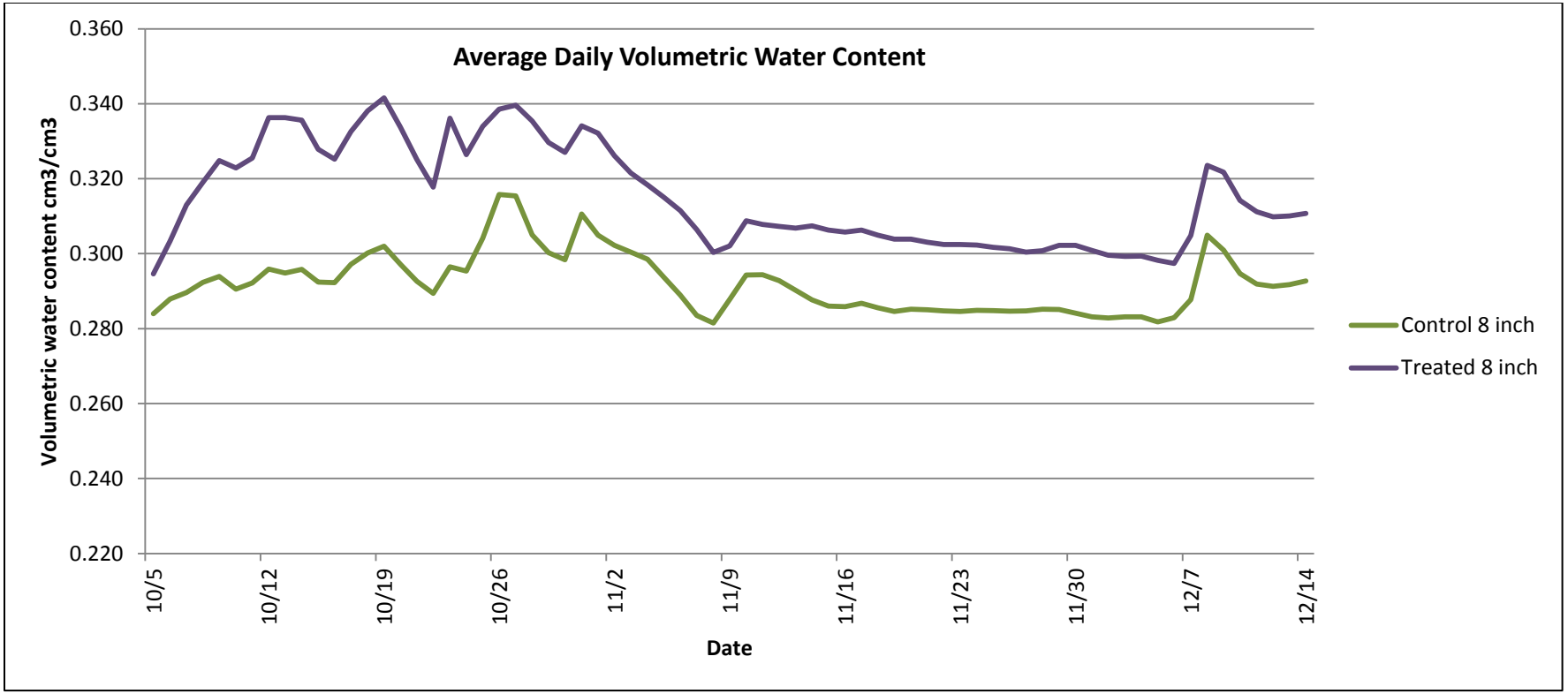

Figure 3. Volumetric water content at the rooting depth (8-inches) in control and treated plots.

Figure 4. The photo on the left is control, while the right is treated. You can see the treated plots have more water movement throughout. Photo taken approximately 2 weeks post-transplant.

Figure 5. Treated (right) and control (left) show that the treated plants were more vigorous and generally had improved color over control plants.

Appendix 1. Weather Data From Trial (GA Weather Network Station, Tifton, GA)

Date	Max Temperature [°F]	Min Temperature [°F]	Rain (in)	Date	Max Temperature [°F]	Min Temperature [°F]	Rain (in)	Date	Max Temperature [°F]	Min Temperature [°F]	Rain (in)
Aug 15	91.9	72.8	0	Oct 03	82.1	65.3	0	Nov 21	67.2	50.7	0
Aug 16	92.7	73.2	0	Oct 04	82.5	64.8	0	Nov 22	70.8	52.7	0
Aug 17	93.8	75.4	0	Oct 05	83.8	62.9	0	Nov 23	60.3	52.4	0.01
Aug 18	94.2	74.9	0	Oct 06	82.5	65.3	0	Nov 24	66.4	42.4	0
Aug 19	94	74	0	Oct 07	88.2	72.5	0.19	Nov 25	67	39.6	0
Aug 20	95.6	71.1	0	Oct 08	82.1	76.1	0.26	Nov 26	69.9	45.1	0
Aug 21	91.5	72.2	0	Oct 09	91.5	75.3	0	Nov 27	68.6	36.3	0
Aug 22	91.4	72.7	0	Oct 10	91.5	73.7	0	Nov 28	76.6	45.6	0
Aug 23	94.1	73.7	0	Oct 11	86.2	72.8	0.29	Nov 29	78.7	54.2	0
Aug 24	94.9	73.6	0	Oct 12	90.3	70.8	0.02	Nov 30	78.3	49.3	0
Aug 25	92.8	72.8	0.13	Oct 13	87.4	68.6	0.01	Dec 01	77.6	55.1	0
Aug 26	89.3	73.7	0	Oct 14	82.6	70.3	0	Dec 02	75.3	51.5	0
Aug 27	85.7	72.4	0	Oct 15	86.2	67.2	0	Dec 03	59.6	52.8	0.01
Aug 28	87.5	69.8	0	Oct 16	85.8	63.6	0.01	Dec 04	72.2	53	0
Aug 29	87.7	66.7	0	Oct 17	71.9	50.7	0	Dec 05	77.6	52.8	0
Aug 30	89.7	71.4	1.42	Oct 18	76.1	48.5	0	Dec 06	66.9	42.7	0.24
Aug 31	87.6	71.4	0.84	Oct 19	80.1	53.7	0	Dec 07	47.2	41.1	0.96
Sep 01	88.6	71	0	Oct 20	82.4	52.9	0	Dec 08	44.4	40.6	1.56
Sep 02	84.6	71.2	0.06	Oct 21	83.4	61.5	0	Dec 09	44.1	33	0.01
Sep 03	89.3	67.9	0.01	Oct 22	86.2	65.8	0.29	Dec 10	50.7	27.5	0
Sep 04	90.3	69.5	0	Oct 23	79.9	57.7	0.98	Dec 11	61.6	30.3	0
Sep 05	88.6	71.6	0	Oct 24	73.7	50.8	0.01	Dec 12	59.7	40	0
Sep 06	83	68.1	0.01	Oct 25	64.8	43.8	0	Dec 13	53.8	32.3	0
Sep 07	81.4	58.9	0	Oct 26	71.7	41.3	0	Dec 14	63	39	0
Sep 08	83.3	61.6	0	Oct 27	75.5	46	0	Dec 15	54.6	40	0
Sep 09	79.1	62.4	0	Oct 28	79	54.4	0				
Sep 10	71.4	59.5	0.44	Oct 29	54.9	40.1	0				
Sep 11	68.7	59.6	3.14	Oct 30	66.8	36.1	0				
Sep 12	80.2	60.1	0	Oct 31	76.2	43	0				
Sep 13	83.2	66	0.04	Nov 01	76.1	46	0				
Sep 14	85.7	64.8	0.02	Nov 02	80.2	52.4	0				
Sep 15	88.3	66.8	0	Nov 03	81.9	54	0				
Sep 16	88.1	68.6	0	Nov 04	83.5	57.2	0				
Sep 17	88.5	66.6	0	Nov 05	83.2	57.1	0				
Sep 18	89.5	64.5	0	Nov 06	83.2	61.6	0				
Sep 19	91.2	68.2	0	Nov 07	82.2	58.9	0				
Sep 20	89.3	68.7	0	Nov 08	80.4	62.9	0				
Sep 21	90	67.5	0	Nov 09	67.9	50.2	0.62				
Sep 22	88.5	66.5	0	Nov 10	66.4	47.7	0.01				
Sep 23	87.1	67.2	0	Nov 11	57.1	46.2	0				
Sep 24	86	68.3	0	Nov 12	65.7	48.1	0				
Sep 25	88.5	65.6	0	Nov 13	71.1	49.5	0.01				
Sep 26	88.5	62.9	0	Nov 14	64.6	46.3	0				
Sep 27	90.6	64.9	0	Nov 15	62.4	40.3	0				
Sep 28	93.2	66.7	0	Nov 16	70.6	39.1	0				
Sep 29	94.1	67.5	0	Nov 17	70.3	45.2	0.01				
Sep 30	86.2	70.1	0	Nov 18	74.2	47.1	0				
Oct 01	74.2	63.9	0.02	Nov 19	66.6	43.6	0.02				
Oct 02	83.1	64	0.02	Nov 20	64	35.3	0				