

Effects of Control Release Fertilizer on Vidalia Onion Production

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A field experiment was conducted in the 2018/2019 Vidalia onion season at the University of Georgia – Vidalia Onion and Vegetable Research Center located in Lyons, GA. The objective was to evaluate different fertilizer strategies including control release fertilizer for Vidalia onion production.

Soil in the experimental area is classified as Irvington loamy sandy soil type with 2% of slope and a low water holding capacity (USDA soil survey, 2018). Climate of the region is classified as a humid subtropical climate called Cfa, characterized by high temperatures with accumulated rainfall events in the spring/summer and dry periods in the fall/winter (Koppen, 1931). Vidalia onion (c.v. Pirate) was planted end of September in nursery beds, and transplanted to field-beds on 19 December 2018.

The experimental area was comprised of 4 adjacent field-beds 5-in tall, 145-ft long, and 6-ft center to center spacing. Each field-bed was comprised of 4 onion rows with an in-row spacing of 4 inches, and experimental plots were 20-ft long with 5 ft skip between plots within each bed. A factorial experimental design with six fertilizer strategies comparing the grower standard practices (GSP) against five (5) control release fertilizer strategies were replicated 4 times in a randomized complete block design. Table 1 has a list of fertilizer strategies with application times, date of fertilizer application, and nutrient rates applied in each application.

Weather conditions (i.e., maximum and minimum temperature, solar radiation, and rainfall) were hourly monitored using a weather station from the Georgia Automated Environmental Monitoring Network (<http://www.georgiaweather.net/>). Crop management practices associated with soil preparation, irrigation and management of pest, weeds and diseases followed the University of Georgia recommendation.

Vidalia onions were harvested on 25 April 2019 (127 DAT), cured for a week and graded according to the Georgia Department of Agriculture in: Colossal ($> 3^{3/4}$ inches), Jumbo ($3^{3/4}$ to $3^{1/4}$ inches), Medium (2 to $3^{1/4}$ inches), Culls (< 2 inches).

Statistical analyses were performed using the software RStudio Version 3.5.1 (RStudio Team, 2018) to compare total yield and bulb size distribution among treatments. When the F value was significant, multiple mean comparisons were performed using the Tukey-Kramer at a p value of 0.05.

Table 1. Description of treatment, number of applications, date, days after transplanting (DAT) and nutrient rates in 2018/2019 season.

Fertilizer strategy	Number of fertilizer application	Application date		N	P	K	Nutrients						
							Mg	Mn	B	Zn	Ca	Fe	S
		Date	DAT				Lbs./acre						
GSP	4	12/19/2018	0	20.0	40.0	60.0	4.0	1.0	0.4	0.4	36.0	0.0	12.0
		1/22/2019	34	20.0	40.0	60.0	4.0	1.0	0.4	0.4	36.0	0.0	12.0
		2/15/2019	58	20.0	40.0	60.0	4.0	1.0	0.4	0.4	36.0	0.0	12.0
		3/21/2019	92	54.0	0.0	0.0	0.0	0.0	0.0	0.0	66.5	0.0	0.0
		Total of nutrient		114.0	120.0	180.0	12.0	3.0	1.2	1.2	174.5	0.0	36.0
CRF - 1	1	12/19/2018	0	96.0	96.0	144.0	12.0	3.0	0.1	1.2	108.0	20.4	50.4
		Total of nutrient		96.0	96.0	144.0	12.0	3.0	0.1	1.2	108.0	20.4	50.4
CRF - 2	2	12/19/2018	0	48.0	48.0	72.0	6.0	1.5	0.1	0.6	54.0	10.2	25.2
		1/22/2019	34	48.0	48.0	72.0	6.0	1.5	0.1	0.6	54.0	10.2	25.2
		Total of nutrient		96.0	96.0	144.0	12.0	3.0	0.1	1.2	108.0	20.4	50.4
CRF - 3	3	12/19/2018	0	72.0	120.0	180.0	12.0	3.0	0.1	1.2	84.0	20.4	50.4
		2/15/2019	58	27.1	0.0	0.0	0.0	0.0	0.0	0.0	33.3	0.0	0.0
		3/21/2019	92	27.1	0.0	0.0	0.0	0.0	0.0	0.0	33.3	0.0	0.0
		Total of nutrient		126.3	120.0	180.0	12.0	3.0	0.1	1.2	150.5	20.4	50.4
CRF - 4	4	12/19/2018	0	36.0	60.0	90.0	6.0	1.5	0.1	0.6	42.0	10.2	25.2
		1/22/2019	34	36.0	60.0	90.0	6.0	1.5	0.1	0.6	42.0	10.2	25.2
		2/15/2019	58	27.1	0.0	0.0	0.0	0.0	0.0	0.0	33.3	0.0	0.0
		3/21/2019	92	27.1	0.0	0.0	0.0	0.0	0.0	0.0	33.3	0.0	0.0
		Total of nutrient		126.3	120.0	180.0	12.0	3.0	0.1	1.2	150.5	20.4	50.4
CRF - 5	5	12/19/2018	0	24.0	40.0	60.0	4.0	1.0	0.0	0.4	28.0	6.8	16.8
		1/22/2019	34	24.0	40.0	60.0	4.0	1.0	0.0	0.4	28.0	6.8	16.8
		2/15/2019	58	24.0	40.0	60.0	4.0	1.0	0.0	0.4	28.0	6.8	16.8
		3/21/2019	92	54.2	0.0	0.0	0.0	0.0	0.0	0.0	66.6	0.0	0.0
		Total of nutrients		126.3	120.0	180.0	12.0	3.0	0.1	1.2	150.5	20.4	50.4

Results

During the Vidalia onion season, there was a rainfall accumulation of 13 inches, which matched with the 12.8 inches of onion water demand for the same period of time (data retrieved from <http://irrigating.uga.edu>). Still, rainfall events were not uniformly distributed throughout the season and irrigation events were required to supply dry periods. In the early season, scattered heavy showers events (January to February) might induced nutrient leaching, particularly nitrogen (N), while, later in the season, there was a well distribution of rainfall events, from mid-season (March) to harvesting (April) (Fig. 1). Therefore, the use of control release fertilizer was key to ensure nutrient availability during the entire season and provide high crop yields.

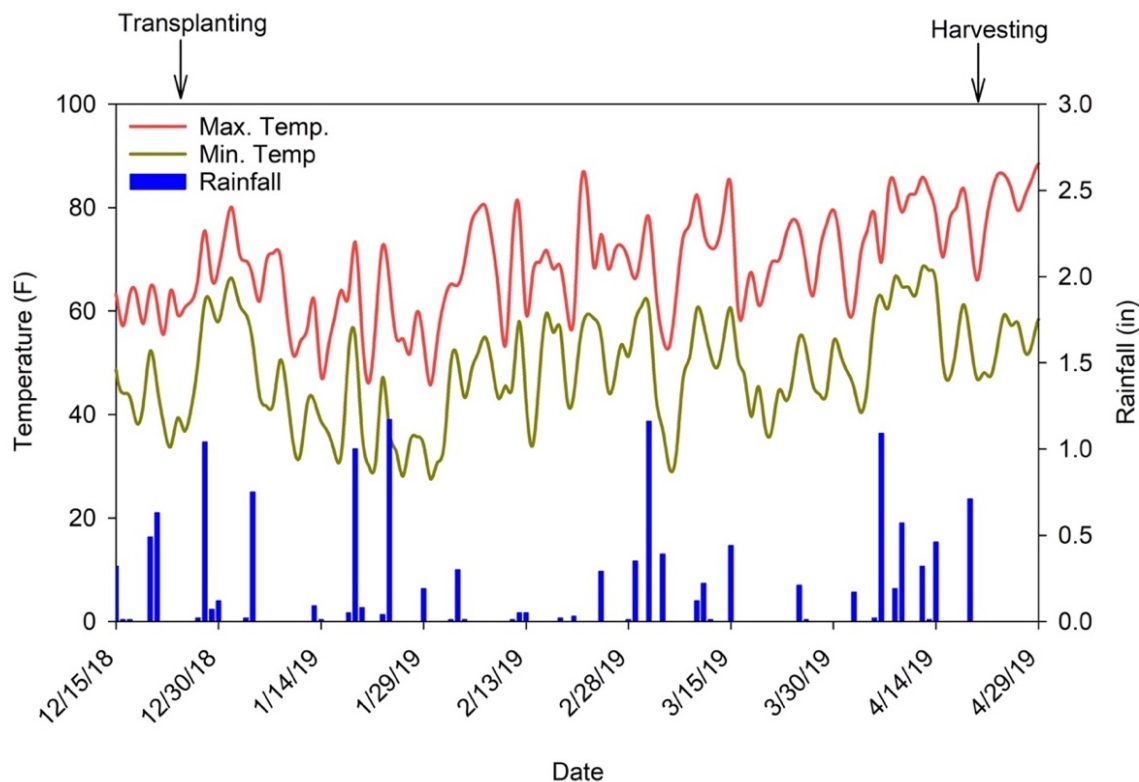


Figure 1. Weather condition of minimum and maximum temperature and rainfall during the 2018/2019 Vidalia onion season in Lyons, GA.

All control release fertilizer strategies increased Vidalia onion total yield compared to the grower standard practice (Table 2). In average, control released fertilizer treatments had 25% higher total yields than the grower standard practice. However, the CRF - 1 and CRF - 2 were the fertilizer strategies that required the lowest number of fertilizer application and nutrient requirements to increase total yield. Regarding bulb size distribution, the CRF - 4 had the highest colossal yield, but this yield was only significantly higher than the grower standard practice, indicating that all control release fertilizer strategies studied similarly yield for colossal bulbs. Jumbo and medium bulbs are sizes of most interest for growers. Control release fertilizer strategies had higher jumbo yields than the grower standard practice. Particularly, the CRF - 1 and CRF - 2, with lower nutrient requirement, had 38% and 35% higher jumbo yield than the grower standard practice, respectively. Contrarily, grower standard practice had the highest yield

of medium bulbs, which indicates that control release fertilizer programs increase bulb size. There was no significant difference among fertilizer strategies for cull bulbs.

Table 2. Total yield and bulb size distribution for Vidalia onion grown in the 2018/2019 season.

Fertilizer strategy	Total yield	Colossal	Jumbo	Medium	Culls
40 lb. bags / acre					
GSP	852 b	5 b	604 b	206 a	37
CRF - 1	1116 a	54 ab	977 a	77 b	21
CRF - 2	1128 a	22 ab	930 a	124 b	56
CRF - 3	1149 a	38 ab	968 a	95 b	46
CRF - 4	1150 a	72 a	914 a	113 b	61
CRF - 5	1160 a	38 ab	914 a	115 b	81
<i>p</i> value	<0.001	0.03	0.001	<0.001	ns

Conclusion

Overall, control release fertilizer strategies increased Vidalia onion yields compared to the grower standard practice for the weather conditions of the studied season (2018/2019), when heavy rainfall events occurred early in the season. Previous studies have indicated that control release fertilizer strategies perform better than the application of dry fertilizer in rainy years. Particularly, the CRF - 1 and CRF - 2 required a lower number of fertilizer application and nutrients applied to increase yield. Nevertheless, a second year of study is required to evaluate the effect of control release fertilizer strategies in Vidalia onion yield for dry years.



Figure 2. Harvesting and grading of Vidalia onion on the control release fertilizer trial during the season of 2018/2019