Update of nitrogen fertilizer management for Georgia's Vidalia onion production

Andre Luiz Biscaia Ribeiro da Silva, Timonthy Coolong, Christopher Tyson, Aubrey Shirley, Laurel Dunn

Introduction

Long growing seasons and relatively shallow root system makes Vidalia onion a crop with high requirements of soil nitrogen (N) availability during crop development. Current recommendations for N fertilizer application for Vidalia onion vary from 125 to 150 lb of N/acre[2]. However, growers have routinely produced high quality Vidalia onion crops using less than N fertilizer recommendations. In addition, much of the work conducted on total N applications was done in the 1980s and 1990s. During the last 20 years, many new varieties with relatively higher nitrogen fertilizer use efficiencies have been released. This should allow for using reduced N rates applied during crop production, consequently reduction on costs with fertilizer input for growers.

Several studies were performed in recent years related to fertility and production practices in Vidalia onions. Although important for growers, these studies were mostly focused in a single variety with limited number of factors. New information on the Vidalia onion requirements for N fertilizer applications would benefit growers. Therefore, research is required to determine N fertilizer recommendations for the current available varieties of Vidalia onion. This research must help growers to reduce costs associated with fertilizer inputs while maintaining yield. Thus, the objective of the study was to identify N fertilizer application rates in different varieties of Vidalia onion that maximize plant growth and yield.

Material and Methods

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. 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, characterized by high temperatures with accumulated rainfall events in the spring/summer and dry periods in the fall/winter (Koppen, 1931).

Vidalia onion was planted on 17 September, 2018 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, 370-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. During the entire season, crop management practices associated with soil preparation, transplanting, irrigation and management of pest, weeds and diseases followed the University of Georgia recommendation.

Five N fertilizer rates and three Vidalia onion cultivars were evaluated in a randomize complete block design with 4 replications (table 1). The N Fertilizer were applied at transplanting, and at 30, 58, and 92 days after transplanting (DAT) to a total N fertilizer rate of 75, 90, 105, 120 and 135 lb/ac., each application timing received 20% of the season total N applied, except by the last application when 40% of the season total N was applied. In addition to N fertilizer application, Vidalia onion plants received a total of 134 lbs/ac of P and K, applied at transplanting and at 25 days after transplanting.

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). Marketable yield was calculated as Colossal, Jumbo, and Medium, while total yield was calculated as Marketable yield and culls. Statistical analyses were performed to compare total yield and bulb size distribution among treatments.

Results and Discussion

Rainfall accumulation was 13 inches during the entire onion season, 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 N applied early in the season, while, later in the season, there was a well distribution of rainfall events, from mid-season (March) to harvesting (April) (Fig. 1).

Vidalia onion yield parameters were mostly affected by the N rate applied instead variety (Table 2). Total yield was the highest for the 105, 120, and 135 lb. of N/acre, indicating that the N rate of 105 lb./acre was sufficient to sustain total yield. Lowest total yields were measured for 75 and 90 lb. of N/acre. Colossal onions represented in average 2% of total yield only, and the N rate of 135 lb./acre had the highest yield of Colossal. Jumbo onions represented in average 62% of total yield. The highest yield for Jumbo onions were measured for the N rate of 135 lb./acre as well, but no significant difference was measured between 135 and 120 lb./acre. The N rate of 105 lb./acre had no significant difference from 120 and 90 lb./acre, while 75 lb./acre had the lowest yield of Jumbo onions. Contrarily to yield of onions size Jumbo, Medium onion had a higher yield for the N rate of 75 lb./acre, following by N rates of 90, 105, and 120 lb./acre. Lowest medium onion yields were measure for 135 lb./acre. Yield of medium onions represented 25% of total yield. N rate treatments had no significant difference for yield of cull onions that represented 11% of total yield.

The Vidalia onion varieties evaluated had minimal impact on yield, and significant differences were only measured for the yield of medium onions, in which QuickStart and Vidora had higher yield of medium onions than Sweet Agent. Total yield, Jumbo, and culls average 849, 536, and 91-40 lb. bags/acre, respectively.

Conclusion

Vidalia onion yield parameters were more affected by N rate than the varieties studied. The N rate of 135 lb./acre had the highest onion yield, but no significant difference was measure from the 105 lb./acre for the 2018/19 Vidalia onion season. This indicated that the application of N rates higher than 105 lb./acre might not be necessary to increase yield. However, a second year of study is required to evaluate the effect of Vidalia onion varieties and fertilizer N rates on yield in a different weather condition, since higher N rates might be required in rainy years and lower N rates in drier years.

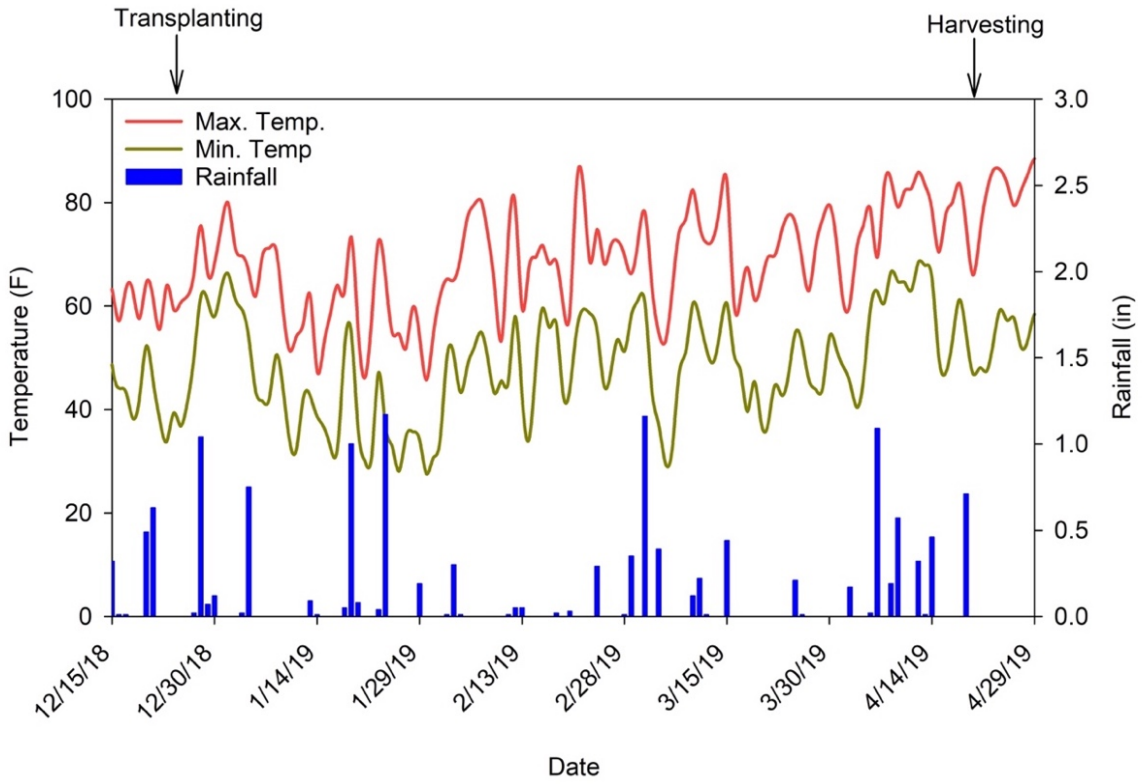

Figure 1. Weather condition of minimum and maximum temperature and rainfall during the 2018/2019 Vidalia onion season in Lyons, GA.

Table 2.

Treatment	Total yield		Colossal		Jumbo		Medium		Culls
					40 lb. bags / acre				
Nitrogen Rate									
135	998	a	42	a	692	a	155	c	109
120	900	a	20	b	618	ab	174	bc	88
105	898	a	12	bc	538	bc	209	b	139
90	761	b	5	c	486	c	214	b	57
75	688	b	2	c	343	d	283	a	61
p-value	*<0.001*		*<0.001*		*<0.001*		*<0.001*		*0.409*
Variety									
QuickStart	848		5	b	496		248	a	99
Sweet Agent	848		32	a	557		147	b	112
Vidora	851		9	b	554		227	a	61
p-value	*0.995*		*<0.001*		*0.079*		*<0.001*		*0.380*
Nitrogen Rate * Variety									
p-value	*0.546*		*0.277*		*0.264*		*0.347*		*0.535*

Table 1.

Treatment	Variety	N rate (lb/ac)
1	Sweet Agent	75
2	Sweet Agent	90
3	Sweet Agent	105
4	Sweet Agent	120
5	Sweet Agent	135
6	Vidora	75
7	Vidora	90
8	Vidora	105
9	Vidora	120
10	Vidora	135
11	Quickstart	75
12	Quickstart	90
13	Quickstart	105
14	Quickstart	120
15	Quickstart	135