



Evaluation of Early Nitrogen Rates on Strawberry Cultivars

BIELINSKI M. SANTOS*

University of Florida, IFAS, Gulf Coast Research and Education Center, 14625 CR 672, Wimauma, FL 33598

ADDITIONAL INDEX WORDS. *Fragaria xananassa*, cultural practices, fertilization, plant nutrition, macronutrients

A study was conducted over two seasons to determine the effects of four early N application rates (0, 0.5, 1.0, and 1.5 lb/acre per day during the first 10 d after transplanting; 1 acre = 10,890 linear bed feet/acre) on the yields of two strawberry cultivars ('Strawberry Festival', a vigorous cultivar, and 'Florida Radiance', a compact-growth habit cultivar). The interaction between early N rate and cultivar was significant for early and total marketable fruit numbers and weights. Early fruit number of 'Florida Radiance' sharply increased when initial N rate was increased from 0 to 0.5 lb/acre per day and remained constant with higher early N rates. In contrast, 'Strawberry Festival' early fruit number steadily increased with early N rates between 0 and 1.0 lb/acre per day. There was no early fruit number difference for plots receiving N at 1.0 or 1.5 lb/acre per day. Total marketable fruit number followed similar trends as those of early fruit number. Early and total marketable fruit weights of 'Strawberry Festival' sharply increased when N fertilization was increased from 0 to 1.0 lb/acre per day. However, increasing early N rates from 1.0 to 1.5 lb/acre per day failed to enhance early fruit weight in 'Strawberry Festival'. In contrast, a daily N rate of only 0.5 lb/acre increased 'Florida Radiance' early fruit weight. These results suggest that early N fertilization programs should be tailored to the strawberry cultivar planted.

Improving economic and environmental sustainability is critical for the future of the strawberry (*Fragaria xananassa*) industry in Florida. This industry generates about US\$362 million in gross sales annually (U.S. Department of Agriculture, 2011). Improved plant vigor after transplanting and proper nitrogen (N) fertilization are among the most pressing issues for growers to enhance crop performance, as well as to reduce production costs and nutrient leaching into the environment. Additionally, prices of N fertilizers have been steadily increasing in the last 15 years (U.S. Department of Agriculture, 2012). Therefore, judicious application of this nutrient during the early stages of growth is desirable.

A few years ago, the common industry practice was to broadcast between 20 and 40 lb/acre of N between 4 and 8 weeks before transplanting. However, this practice proved to be unnecessary (Santos and Whidden, 2010). Instead, recent surveys among growers revealed that most strawberry growers inject N at between 0.5 and 1.5 lb/acre (1 planted acre = 10,890 linear feet of raised bed) through fertigation during the first 10 d after transplanting to satisfy early N crop requirements. Furthermore, even if growers use strawberry varieties with different growth habits, the same rates are used across all cultivars. This could lead to unnecessary N fertilization in some cases. The objective of this study was to determine the effects of early N application rates on the yields of two strawberry cultivars.

Materials and Methods

Two field trials were conducted in the fall of 2010 and 2011 at the University of Florida's Gulf Coast Research and Educa-

tion Center in Wimauma, FL on a sandy, siliceous, hyperthermic Oxyaquic Alorthod soil with <1.5% organic matter and a pH of 6.6. Prior to the experiment, the soil was tilled twice to an approximate depth of 8 inches to ensure proper soil structure. In mid-August of each season, planting beds were formed using a standard bedder, which pressed beds 27 inches wide at the base, 24 inches wide at the top, and 8 inches high. Bed spacing was 4 ft. Simultaneously with bedding, the soil was fumigated with 350 lb/acre of methyl bromide + chloropicrin (67/33, v/v). Within 1 min after fumigation, a single drip tape (0.23 gal/100 ft per min, T-Tape Systems International, San Diego, CA) was buried 2 inches below the surface in the center of the bed. Beds were covered with black, high-density polyethylene mulch (0.025 mm thick, Intergro Co., Clearwater, FL). The experimental area was equipped with 4 gal/min sprinklers for transplant establishment and frost protection.

Selected N rates were 0, 0.5, 1.0, and 1.5 lb/acre per day applied during the first 10 d after transplanting. Calcium nitrate (15% N) was the N source. A hydraulic injector (Dosatron, Clearwater, FL) was used to inject the fertilizer daily with the last irrigation cycle. No preplant N fertilizer was used. Canada-produced 'Strawberry Festival' and 'Florida Radiance' bare-root transplants with three to five leaves (Lareault Nursery, Lavaltrie, Quebec, Canada) were planted in double rows 12 inches apart at a within-row spacing of 15 inches on the first week of October of each season. Each plot consisted of 20 plants and was 12.5 ft long, with a 15-ft-long non-treated buffer zone at the end of each plot to restrict lateral water movement between adjacent plots. Eight treatments (four early N rates and two cultivars) were set up in a split-plot design with five replications during each season. Rates of N were in the main plots. Immediately after transplanting, overhead irrigation was applied between at 8 AM and 4 PM

*Corresponding author; phone: (813) 634-0000; email: bmsantos@ufl.edu

during the first 10 d to ensure plant establishment. Other plant nutrients were applied under non-limiting conditions following current fertilization practices for the crop. Recommendations for insect and disease control were also followed, depending on pest pressure.

Marketable strawberry fruit with the calyxes attached were harvested and weighed twice per week for a total of 24 harvests starting at 8 weeks after transplanting (WAT). A marketable fruit was defined as one over 10 g in weight and physiologically mature with more than 80% of the fruit surface dark red, free of mechanical defects, and free of insect or disease injury. Early and total marketable fruit weights and numbers consisted of the first 10 and the total 24 harvests, respectively. Data were analyzed using linear regression analysis and general linear model ($P < 0.05$) and treatment values were separated using standard error bars (Statistix Analytical Software, version 9, Tallahassee, FL).

Results and Discussion

Data from both years were combined for analysis because the treatment by season interaction was not significant for any of the measured variables. The interaction between cultivars and early N rates was significant for early and total marketable fruit numbers. Therefore, the combinations of both factors were analyzed for data interpretation. Early fruit number of 'Florida Radiance' sharply increased from nearly 157,000 to more than 232,000 fruit/acre when initial N rates were increased from 0 to 0.5 lb/acre per day and remained constant with higher early N rates (Fig. 1A). In contrast, 'Strawberry Festival' early fruit numbers steadily increased with early N rates between 0 and 1.0 lb/acre per day (from nearly 121,000 to more than 183,500 fruit/

acre). However, there was no early fruit number difference for 'Strawberry Festival' plots treated with N at 1.0 or 1.5 lb/acre per day. Total marketable fruit number followed similar trends as those for early fruit number with 'Florida Radiance' fruit number increasing when N was applied at 0.5 lb/acre per day compared with 0 lb/acre (Fig. 1B). 'Strawberry Festival' plots treated with N at 1.5 lb/acre per day had higher total fruit numbers than those that received no initial N fertilization. However, there was no fruit number difference between 'Strawberry Festival' plots treated with N at 1 or 1.5 lb/acre per day.

Early and total marketable fruit weights were interactively influenced by the two factors under study. 'Strawberry Festival' early fruit weight sharply improved from 2.2 to 3.6 tons/acre when N fertilization was increased from 0 to 1.0 lb/acre per day (Fig. 2A). However, increasing early N rates from 1.0 to 1.5 lb/acre per day failed to enhance early fruit weight in plots planted with 'Strawberry Festival'. In contrast, a daily N rate of only 0.5 lb/acre increased 'Florida Radiance' early fruit weight from 2.8 to 4.7 tons/acre. No further early fruit weight changes occurred when 'Florida Radiance' plots received N at more than 0.5 lb/acre per day. With regard to total fruit weight, an initial N rate of 0.5 lb/acre was sufficient to improve 'Florida Radiance' yield from 11.8 to 18.9 tons/acre (Fig. 2B). However, higher N rates did not affect 'Florida Radiance' total fruit weight. Fruit weight of 'Strawberry Festival' reached maximum values when plots were treated with initial N rates between 1.0 and 1.5 lb/acre per day, ranging between 12.8 and 13.5 tons/acre, which surpassed the 9.1 tons/acre obtained without initial N fertilization.

These results suggest that designing early N fertilization programs for strawberry depends on the planted cultivar. At the same time, the data supports previous descriptions of the growth

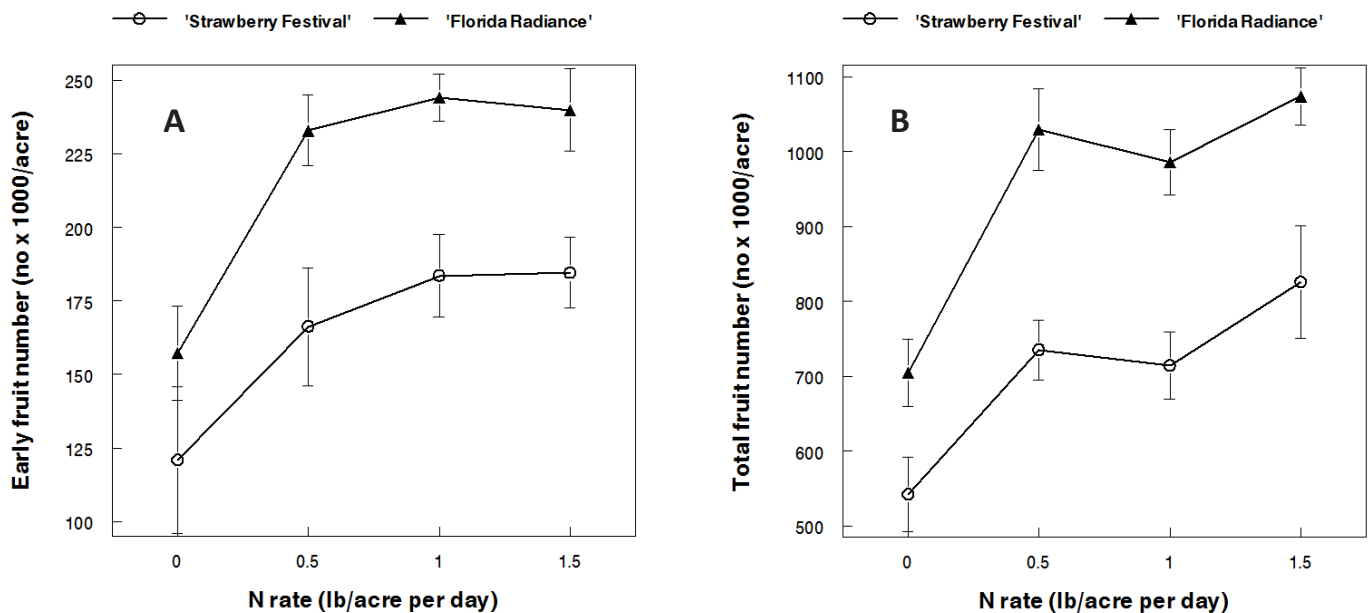


Fig. 1. Effects of different early nitrogen (N) rates on early (A) and total (B) fruit numbers of 'Strawberry Festival' and 'Florida Radiance' strawberries (1 acre = 10,890 linear bed feet). Significant means ($P < 0.05$) compared with SE values.

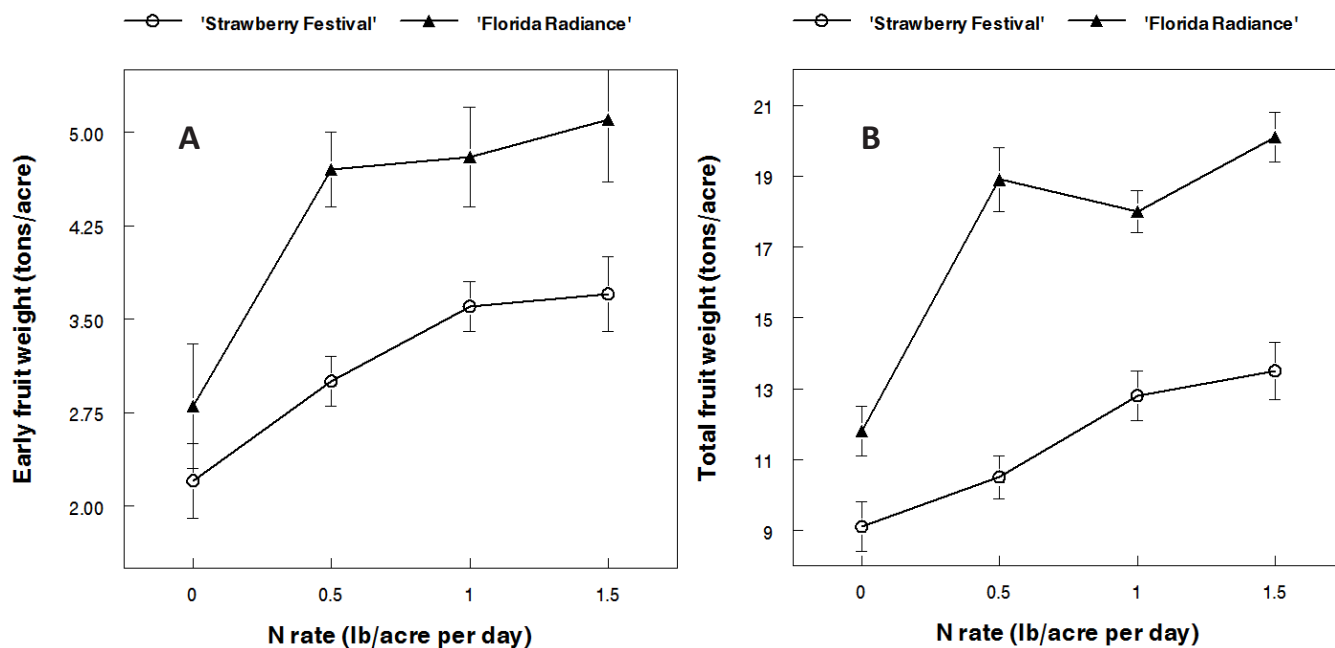


Fig. 2. Effects of different early nitrogen (N) rates on early (A) and total (B) fruit weights of 'Strawberry Festival' and 'Florida Radiance' strawberries (1 acre = 10,890 linear bed feet). Significant means ($P < 0.05$) compared with SE values.

habits of the two strawberry cultivars. On one hand, 'Strawberry Festival' has a vigorous rooting system and aboveground bush, while 'Florida Radiance' is a small plant with likely less initial N requirement than the former cultivar (Whitaker et al., 2012). This also somewhat agrees with previous research that determined that seasonal N rates in Florida needed to be adjusting according to the selected cultivars (Santos and Chandler, 2009). This study does not support the current practice by some growers of injecting 1.5 lb/acre per day of N during the first 10 d of the strawberry growing season; stopping this practice could, in the case of 'Florida Radiance', save significant amounts of drip-applied N in the Plant City-Dover agricultural area.

Literature Cited

- Santos, B.M. and C.K. Chandler. 2009. Influence of nitrogen fertilization rates on the performance of strawberry cultivars. *Intl. J. Fruit Sci.* 9:126-135.
- Santos, B.M. and A.J. Whidden. 2010. Nitrogen fertilization of strawberry cultivars: Is preplant starter fertilizer needed? *Fla. Agr. Expt. Sta. HS-370*. <<http://edis.ifas.ufl.edu/hs370>>.
- U.S. Department of Agriculture. 2011. *Vegetables 2010 summary*. 1 May 2011. <<http://usda.mannlib.cornell.edu/usda/current/VegeSumm/VegeSumm-01-27-2010.pdf>>.
- U.S. Department of Agriculture. 2012. *Fertilizer use and price*. 2 July 2012. <<http://www.ers.usda.gov/data-products/fertilizer-use-and-price.aspx>>.
- Whitaker, V.M., B.M. Santos, and N.A. Peres. 2012. University of Florida strawberry cultivars. *Fla. Agr. Expt. Sta. HS-1199*. <<http://edis.ifas.ufl.edu/pdf/HS/HS119900.pdf>>.