Nitrogen Nutrition of Containerized *Thuja x* 'Green Giant'

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Nature of Work: Nursery profits depend, in large part, on rapid growth of high quality plants. A short interval of time from liner to sale of a plant translates typically to increased revenue, and often dictates whether the plant is commonly grown in the industry. Fertilizers increase plant growth and thus shorten production time. Due to the increased cost of fertilization, growers are attempting to maintain nutrient concentrations and application frequencies that will supply the required mineral nutrients while avoiding wasteful over-applications. Excessive fertilization is not only financially wasteful, but increases the possibility of nutrient leaching and thus, potential environmental hazards. Identifying a minimal fertilizer application rate that will maximize growth is both economically and environmentally sound.

Keeping the aforementioned goals in mind, nitrogen (N) nutritional requirements were determined for container growth of *Thuja x* 'Green Giant' ('Green Giant' arborvitae). This cultivar was chosen because, although still relatively unknown, 'Green Giant' arborvitae has the potential to become a popular mass-market plant. Desirable attributes of 'Green Giant' arborvitae include: a rapid rate of growth becoming a tall, pyramidal evergreen tree (ideal for a screen) (3); ease of propagation by stem cuttings at any time of the year (1); lack of significant pest problems; outstanding summer foliage; and adaptability to a wide range of soils and climatic conditions (Hardiness Zones 4-9). Identifying nutritional requirements now could save years of wasteful fertilizer application. Nitrogen nutrition was chosen because it is the mineral nutrient that most dramatically influences plant growth (2), and also is the nutrient most closely manipulated by growers.

Uniform rooted cuttings were potted into 3.8 L (#1) black plastic containers filled with a standard substrate of 8 pine bark : 1 sand (by volume) amended with 1.8 kg/m^3 (3 lbs/yd^3) dolomitic limestone. Containers were placed in a glass greenhouse under natural photoperiod and irradiance with days/nights of 24 ± 5C (75 ± 9F)/ 18 ± 5C (65 ± 9F) and irrigated with tap water until treatment initiation. When treatments were begun, plants were fertigated each Monday, Wednesday, and Friday with a complete nutrient solution that varied only in N (supplied by NH_4NO_3) at concentrations of 0, 10 (0.001%), 20 (0.002%), 40 (0.004%), 80 (0.008%), 160 (0.016%) or 320 ppm (0.032%). In addition to these seven treatments, three rates of a controlled-release fertilizer were also included and these plants were irrigated with tap water each Monday, Wednesday, and Friday. Osmocote Plus 15-10-12 (The Scotts Co., Marysville, OH) was top-dressed at rates of 6, 12 or 18 g (0.2, 0.4 or 0.6 oz) per container, representing low, medium, and high application rates, respectively. Container leachate was collected to determine electrical conductivity (EC) of substrate solution, using the pour-through nutrient extraction method (6), 14 days after treatment initiation and every 2 weeks thereafter. Fertigation/irrigation was applied at a volume sufficient to maintain a 25% leaching fraction that was monitored every 2 weeks. No other irrigation was required. The experiment was a randomized complete block design with nine single plant replications per treatment.

After 15 weeks, roots were washed free of substrate and each plant separated into roots and shoots. Dry weights of roots and shoots were determined after drying at 70C (158F) for 96 hr. Prior to drying, five replications were used to determine root area and root length using a Monochrome Agvision System 286 Image Analyzer (Decagon Devices, Inc., Pullman, WA). Measurements were used to calculate root : shoot ratio (root dry weight ÷ shoot dry weight) and root diameter (root area (root length). Data were subjected to ANOVA, regression analysis, and a segmented linear regression (quadratic plateau) was fit to the data using PROC NLIN (4).

Results and Discussion: Even though ‘Green Giant’ arborvitae has a very rapid rate of growth, results indicate it does not require unusually high concentrations of N. Shoot dry weight of liquid fed plants reached a maximum with 100 ppm (0.01%) N, and remained constant throughout the higher N rates (Fig. 1A). Electrical conductivity of substrate solution at maximum growth averaged 0.94 dS/m, which is within the recommended range for fertigated, container-grown nursery crops (5). Although root dry weight and root length decreased dramatically with N application, the two remained constant when N was applied at rates > 50 ppm (0.005%) (data not presented). Shoot dry weight when N was provided by Osmocote Plus reached a maximum at 10 g (0.35 oz) (Fig. 1B). Root dry weight was unaffected by Osmocote application (data not presented). Average EC of substrate solution for maximum growth with Osmocote Plus was 0.79 dS/m which is slightly higher than the range recommended by the Southern Nursery Association (0.2 to 0.5 dS/m) (5).

Significance to Industry: Results demonstrate high rates of N are unnecessary to achieve rapid growth of containerized 'Green Giant' arborvitae. Plants that were fertigated three times weekly achieved maximum shoot growth with as little as 100 ppm (0.01%) N with no additional benefits from higher concentrations. Likewise, plants receiving N from a controlled-release fertilizer attained maximum shoot growth with an application rate slightly under the medium rate (12 g) recommended by the manufacturer. These results indicate that growers should be able to save money and reduce possible environmental hazards by avoiding over-fertilization of container-grown 'Green Giant' arborvitae.

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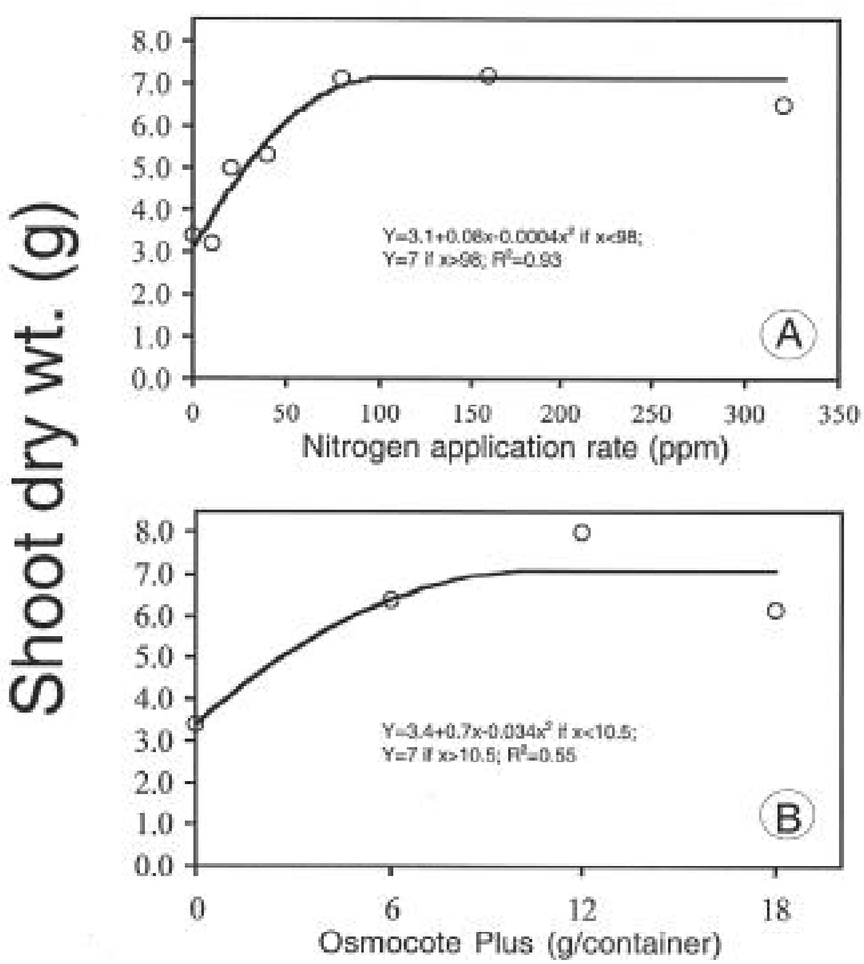

Fig. 1. Shoot growth of 'Green Giant' arborvitae as influenced by nitrogen fertilization provided by (A) liquid feed or (B) controlled-release fertilizer.