Reducing nitrogen applications in watermelon while increasing yields

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Objective: With the emphasis on reducing excess nutrients applied to Maryland vegetable fields, which will reduce nutrient movement into the Chesapeake Bay, this research examined supplying nitrogen to watermelon plants only when needed as determined by the plant's nitrate content.

Introduction: Nitrogen is one of the nutrients often supplied in excess to vegetable fields to ensure a good yield and quality of produce. Growers in the past have had to rely on the final yield to tell them if enough nitrogen was used on the field. This method told them nothing about if too much nitrogen was used in the production of their crop. One method to determine if the plant has enough nitrogen is to test for the nitrate content of the plant. One technique is to take tissue samples that are dried and sent off for analysis. This is time consuming and expensive and does not give growers time sensitive feedback. A real-time method used in the field is to test the plant petiole sap. The petiole concentrates nitrates and other nutrients that are then used in the leaf. Through several years of research on many vegetables a guide has been created that gives growers a range of values of nitrate concentration in the plant petiole sap for a given vegetable at a particular developmental point. If nitrate values fall within the range then plant growth and yield will be at their most efficient point. If the values are above the range there will be little increase in yield for the amount of nitrogen applied, i.e., the plant has too much nitrogen. If the values fall below the range the plant is short of nitrogen and will suffer yield and quality loss if nitrogen is not added.

Vegetable production fields are often irrigated using drip irrigation tubes. Not only can water be applied through the drip tubes, but so can nutrients and other chemicals. This would allow a grower to measure nitrate concentrations in the plant and apply nitrogen if needed. This would ensure that the plant has the nitrogen it needs at the time it needs it without having excess amounts in the soil. This experiment examined using a Cardy meter to measure the petiole nitrate concentration in watermelon to determine when nitrogen should be added through the drip irrigation.

Materials and methods: The experiment took place at the Upper Marlboro research center in 2008. Four levels of nitrogen concentrations were applied to the field in rows 4 ft wide by 100 ft long: Two rows of 80lbs of actual nitrogen applied (nitrogen source was a 50-0-0 calcium nitrate, one row received only 80lbs of N while the other row (80+) would receive the 80 lbs plus more nitrogen fed through the drip when needed), one row of 120 lbs and one row of 150 lbs. There were 4 replications. Watermelon transplants (*Crimson Sweet*) were set three ft apart within rows on June 10. Petiole sap readings were taken weekly three weeks after transplanting by crushing 10 watermelon leaf petioles per

row using a garlic press. Leaves selected for sampling were taken from the middle of a vine. The resulting sap was collected in vials and placed in a cooler until transported back to the lab where a few drops were placed on the Cardy meter for measurement. Once readings neared the bottom of the recommended range for the 80lbs per acre treatment an application of 20 lbs of urea was applied within 3 days only to the 80+ lbs treatment. Yields (number and weight) were taken on August 5.

Results and Discussion: Nitrate levels only neared the lower part of the recommended range once when watermelon fruit was the size of a softball in the 80 lbs of nitrogen treatments. Twenty pounds of urea was then applied to the 80+ rows only. Weight of watermelon yield was significantly greater for the 80+ treatment compared with the 80 lbs treatment (Fig 1, Columns with different letters are significantly different from one another at the P≥0.05 level, using orthogonal contrasts). The 80+ treatment was numerically the greatest yielding treatment compared with the 150 or 120 lbs of N treatments. There were no differences in the number of watermelon fruit between treatments with an average of 17.7 fruit per treatment. This indicates that fruit set was the same for all nitrogen treatments. The Brix percentage (a measure of the soluble solids (sugar content) of a watermelon fruit, a Brix concentration of 10% is considered a good value for watermelon sweetness by the USDA) showed that the 150 and 80+ treatments were above 10% while the 120 and 80 lbs were just below 10% (Fig 2).

Fig. 1 Precision Nitrogen Application and Watermelon Yields

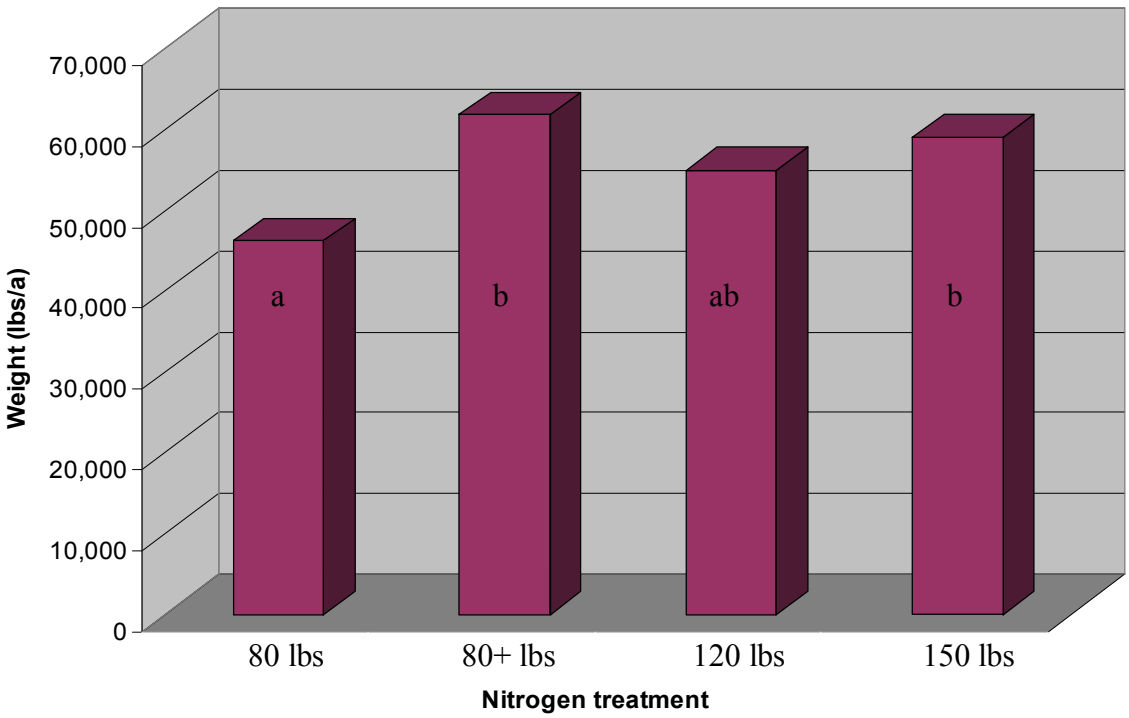
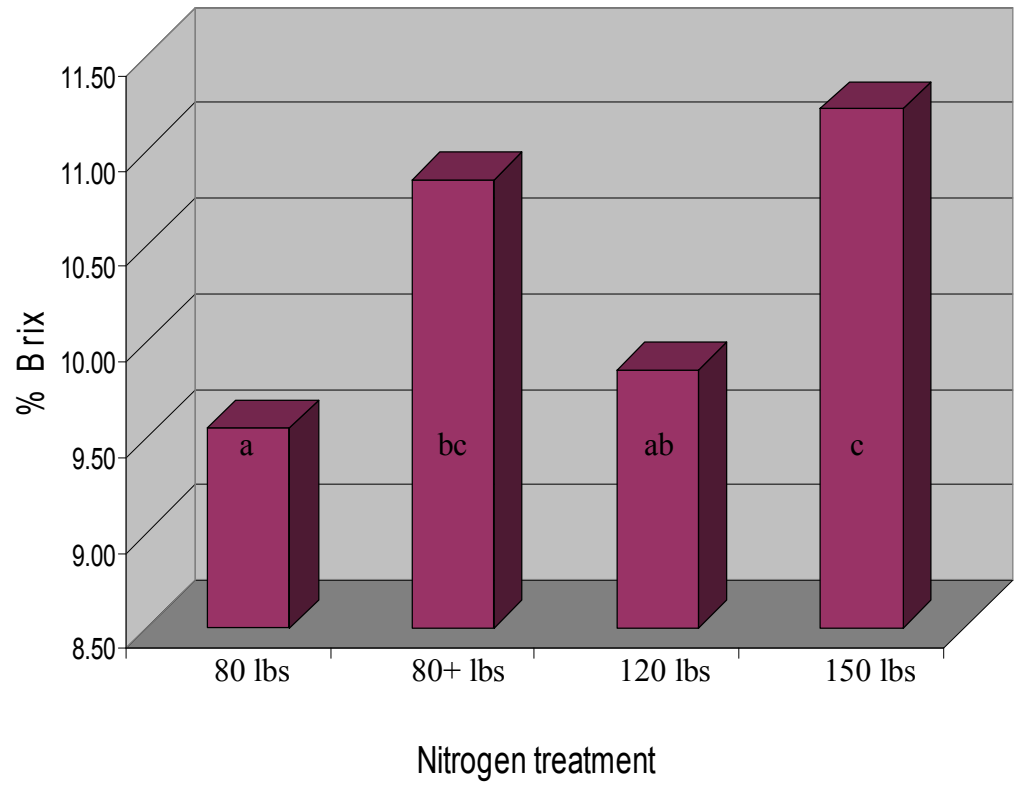
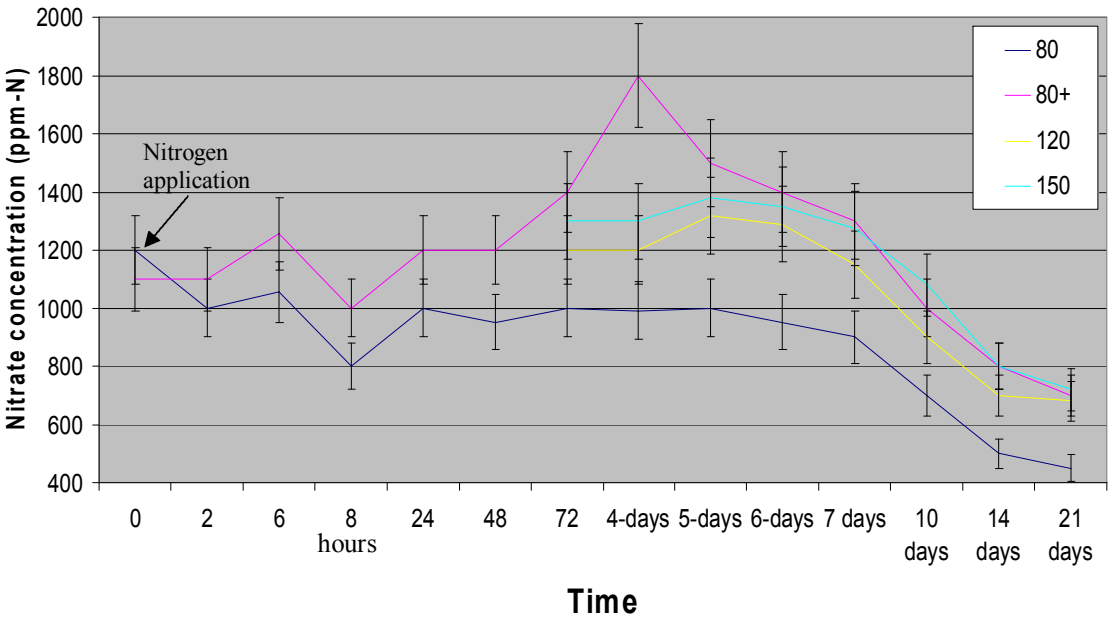


Fig. 2 **Precision Nitrogen Applications and Brix Concentration**



To see how quickly the plant takes up an application of nitrogen I measured the nitrate concentration in the leaf petiole sap of watermelon in the rows that we applied urea to and those rows that we did not. Samples were only taken from the 80 lbs and 80+ lbs of nitrogen treatments for the first 48 hours, thereafter all nitrogen treatments were sampled. Nitrate concentrations increased greatly after 24 hrs and significantly at 48 hrs in the rows in which it was applied compared to the rows it was not. Nitrate concentrations were significantly greater in the 80+ treatments than the 120 or 150 lbs of nitrogen treatments 4 days after urea was applied. Ten days after application there was a rapid drop in all treatments. By harvest (21 days after application) readings for all but the 80 lbs of nitrogen treatment were approximately 750 ppm.

Fig. 3 Precision nitrogen application and nitrate concentration in leaf petiole sap over time



Summary: Applying nitrogen at a critical time when the plant most needed it resulted in similar yield and quality of fruit while nitrogen usage was cut 30% (from 150 to 100lbs, 50lbs less nitrogen per acre). In addition, adding nitrogen at the critical time when petiole nitrate levels reached the low threshold resulted in increased fruit sugar content (above 10%) over the treatment without the targeted second N application. Watermelon plants took up the applied nitrogen quickly with differences being observed 24 hrs after application and significant differences after 48 hrs. These differences continued between the 80 and 80+ treatments to harvest. These results are similar to previous watermelon yield studies I conducted in 2006 and 2007 and indicate that yields can be either maintained or increased by using less total nitrogen and timing applications to when plants will best utilize the nutrient. Similar studies will be conducted in the coming years, to determine if precision or targeted N applications can reduce overall nitrogen usage in other vegetable crops without reducing yield.