Watermelon Response to Soluble and Slow Release Nitrogen Fertilizers

Thomas A. Doerge, Jerome Pier, and Ted McCreary

Abstract

A field experiment with subsurface drip irrigated watermelon was conducted on a Casa Grande s.l. soil at the Maricopa Agricultural Center in 1992 to evaluate the field performance of two slow release nitrogen (SRN) fertilizers in comparison to a conventional soluble N source, urea, ammonium-nitrate (UAN-32). Single, preplant applications of 0, 100 and 200 lbs N/acre supplied from methylene urea (Nutralene®) or 100, 150 and 300 lbs N/acre from a methylene urea-ammonium sulfate mixture (MUAS) were evaluated in comparison to treatments of UAN-32 containing from 52 to 445 lbs N/acre made in five split applications. Yield response to N rates above 100 lbs/acre were similar for all three N sources, indicating that a single, preplant application of a suitable SRN material at an adequate rate could provide N efficiently over the entire growing season. The highest numerical yield (49.3 tons/acre) was obtained with a N rate of 150 lbs N/acre from the MUAS material. Monitoring of petiole nitrate levels throughout the season indicated that N release from the MUAS was more rapid and more complete than from the methylene-urea product. At suboptimal N rates, i.e. < 150 lbs N/acre, split applications of UAN-32 appeared to be somewhat more efficient than the slow-release products.

Introduction

The use of slow release nitrogen (N) fertilizers has several potential advantages. First, it may improve N use efficiency by decreasing denitrification and leaching losses of nitrate-N in comparison to conventional soluble N sources, and second, it can lower labor costs needed to make multiple applications of N fertilizers. Doerge et al. (1991) found that slow release N materials had the potential to effectively supply N all season long to melon varieties from a single preplant application. Careful synchronization of the N release rate from the fertilizer with the N uptake requirement of the crop appeared to be the most critical factor in effectively using slow release materials. The objective of this research was to compare the growth and yield of subsurface drip irrigated watermelon in response to varying rates of two slow release N fertilizers and a conventional soluble N fertilizer.

Materials and Methods

'Mirage' watermelon was grown at the Maricopa Agricultural Center in 1991 using subsurface trickle irrigation with varying preplant rates of two slow release N materials and five soil applications of a conventional soluble N source. The soil at this site is a Casa Grande sandy loam (Coarse-loamy, mixed, hyperthermic Typic Natrargid (reclaimed), with an initial soil test level of 3.9 ppm NO -N (very low). Melon beds were formed using a commercial bed shaper on east-west oriented rows with an 80-inch spacing between rows. In the same field operation, Chapin Turbulent Flow drip tubing lines were buried about 8 inches below the soil surface on the steeper south-facing side of the bed. The tubing had a flow rating of 0.5 gallons per minute per 100 feet and an emitter spacing of 9 inches.

A single row of seeds were precision planted by hand on 18 April and thinned to a final population of 3270 plants per acre on 14 May (4 to 5 leaf stage). This resulted in an interplant spacing of 24 inches. Water was applied daily to supply about 120 % of the consumptive use of watermelon; a total of 49.2 inches of water was applied. Five large bee hives were brought in just prior to the first bloom stage to facilitate uniform early pollination.

The N treatments applied are listed in Table 1. All treatments were replicated three times in a randomized complete block design. Individual plots were 50 feet in length, with melon yields measured from the interior 35 feet of the plots. The slow release N materials were banded in the soil within 1-2 inches of the placement zone of the drip tubing lines immediately prior to drip tube installation. The plots receiving five split applications of urea-ammonium nitrate (Treatments 7-10) were in a separate experiment immediately adjacent to the slow release N plots and received identical cultural practices. A uniform application of 150 lbs of P O as phosphoric acid (0-26-0) was applied with the germination waters to simulate a banding of phosphate fertilizer with the slow release products.

Petiole tissue samples from the youngest fully mature leaves were taken at the 3-4 leaf (14 May), early runner (28 May), 2"-6" melon (20 June) and full-size melon (2 July) growth stages for nitrate analysis. About 15-20 petioles were sampled from each plot. During the season, developing fruits were inspected weekly with cull melons removed and discarded immediately.

At melon maturity, ripe, marketable melons were harvested twice weekly and individually weighed. None of the N treatments appeared to significantly affect earliness so only total melon yields will be reported.

Results and Discussion

The yield of marketable melons in response to the various N treatments is shown in Figure 1. Visual N deficiency symptoms of pale foliage and reduced vine vigor in addition to large reductions in melon yield were observed in plots receiving no more than 100 lbs N/ acre regardless of the N source. Under N deficient conditions, it appeared that N utilization efficiency was slightly better when N was supplied from split applications of urea, ammonium-nitrate rather than the slow release products.

There were little statistical or practical differences in the N response functions for the three N sources above the N rate of 150 lbs N/acre. In no cases did increasing the N rate above 200 lbs N/acre result in significant increases (or decreases) in melon yield. The highest numerical yield was recorded in the plots receiving 150 lbs of N/acre from the methylene urea-ammonium sulfate material. The melon yields attained in the plots receiving adequate N were at least double the Arizona state average over the past five years (18 tons/acre), indicating that growth conditions were at least as comparable to commercial conditions.

The seasonal trends in petiole nitrate concentrations for plants receiving the varying rates of slow release N forms are shown in Figure 2. Petiole nitrate readings from the control plots were in the "deficient" range for essentially all of the growing season. This confirms visual observations of severe N deficiency symptoms throughout the season. The 100 lb N/acre treatments of MUAS and methylene urea and even the 200 lb N/acre treatment all resulted in petiole nitrate levels in the "warning" zone for most of the season. In contrast, the 150 and 300 lb N/acre MUAS treatments resulted in petiole nitrate values predominately in the "adequate" range. The petiole nitrate concentrations measured in the 100 lb N/acre MUAS treatment were consistently greater than or equal to those observed in plants receiving the comparable N rate from methylene urea. Likewise, petiole nitrate levels from the 150 lb N/acre treatment from MUAS were consistently higher than the NO -N concentrations in the petioles from plots receiving 200 lbs N/acre from methylene urea. These observations clearly suggest that N release from the MUAS was more rapid and more complete than from the methylene urea material.

Summary and Conclusions

In this experiment, excellent yields of watermelon were attained in all plots not subject to nitrogen deficiency. Optimum yields were achieved with the application of at least 150 lbs N/acre as MUAS or 200 lbs N/acre as methylene urea or urea, ammonium-nitrate. Rates below 150 lbs N/acre from any source were inadequate to alleviate N deficiency and resultant loss of yield. However, split applications of suboptimal levels of soluble fertilizer did appear to achieve somewhat higher yields than comparable one-time preplant applications of either slow release N fertilizer.

Single, preplant applications of methylene urea and MUAS in amounts needed to produce optimum melon yields were as efficient as equivalent rates of urea, ammonium nitrate applied in five split amounts. The application of 150 lbs N/acre as MUAS appeared to result in the most efficient nitrogen utilization. Release of N from MUAS appeared to be more rapid and more complete than from the methylene urea.

Table 1. Nitrogen fertilizer treatments applied to subsurface drip irrigated 'Mirage' watermelon.

Nitrogen Source	Number of Split Applications	Total N Applied lbs N/acre
1. Control	-	0
2. Methylene-urea	1	100
3. Methylene-urea	1	200
4. MUAS*	1	100
5. MUAS	1	150
6. MUAS	1	300
7. UAN-32*	5	52
8. UAN-32	5	192
9. UAN-32	5	281
10. UAN-32	5	445

*MUAS refers to a methylene urea-ammonium sulfate mixture and UAN-32 refers to urea, ammonium nitrate solution which contains 32% nitrogen.

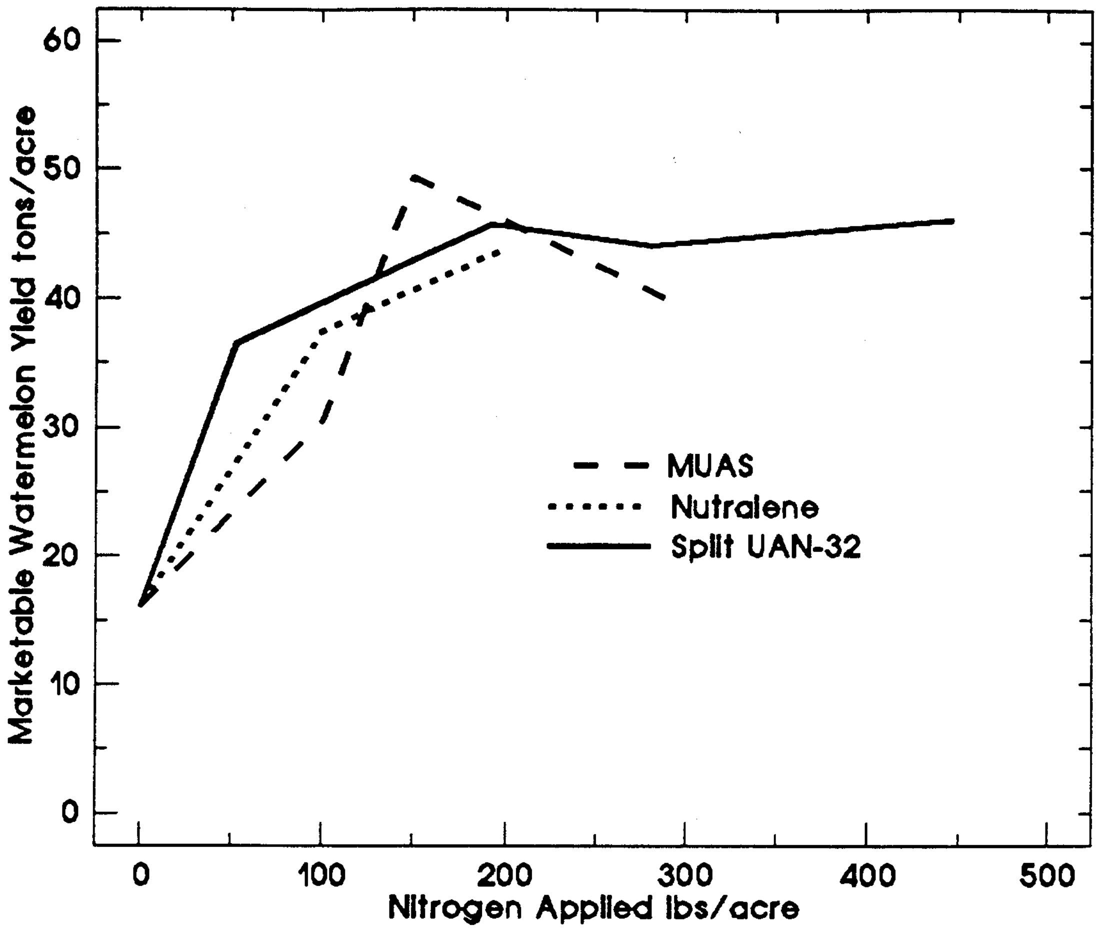

Figure 1. Marketable yields of Mirage watermelon receiving different rates of Nutralene, MUAS and UAN-32.

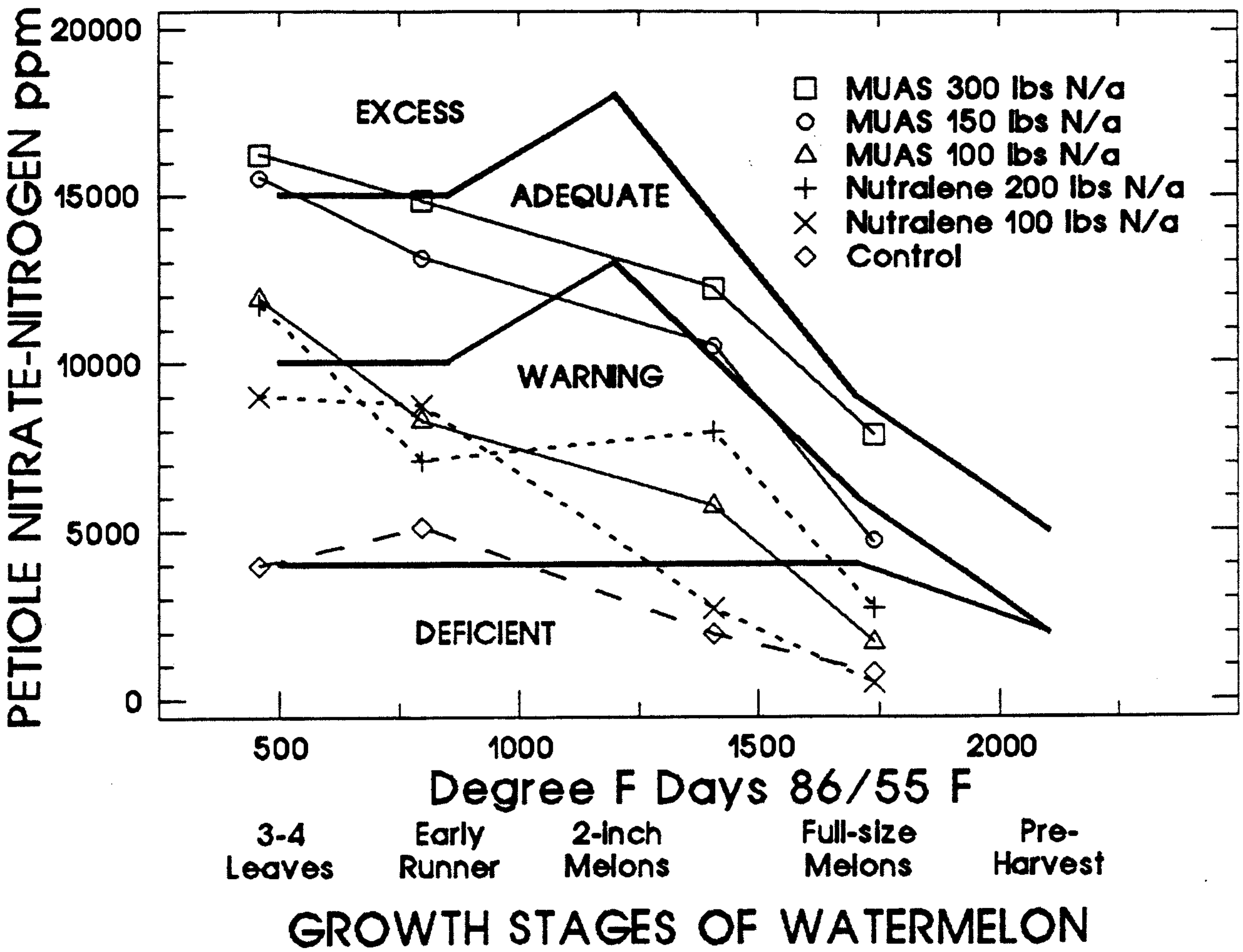

Figure 2. Season trends of nitrate concentrations in watermelon petioles from plots receiving different rates of Nutralene and MUAS.