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Fertilizer Nitrogen Sources for Vegetable Production

Robert Wiedenfeld and Michael Braverman
Texas A&M University Agricultural Research & Extension Center, 2415 East Highway 83, Weslaco, Texas 78596

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Abstract. **Vegetable growers have a continuing concern that nutrition may be limiting vegetable production. Nine fertilizer N sources were tested to determine the effects of formulation and availability on yields and grades of onions and bell peppers. Fertilizer application increased onion yields over the unfertilized check; but no difference in yield, bulb or fruit size due to different fertilizer sources was found for peppers or onions. One slow-release material increased N uptake by onions over the fertilizer containing mostly NO_3^- but this did not result in a yield effect. Calcium, sulfur or other nutrients made available as pH declines were apparently not limiting. Use efficiency of applied N was low, indicating that much of the fertilizer N could evolve as a pollutant.**

Abstracto. **Agricultores de hortalizas tienen la prrocupción continua de que la nutrición puede estar limitando la producción de hortalizas. Nueve fertilizantes fuentes de nitrógeno (N) fueron puestos aprueba para determinar los efectos de la formulación y disponibilidad en el rendimiento y grados de cebollas y chiles bell. La aplicación de fertilizantes aumentó el rendimiento de cebollas sobre el control sin fertilizar; pero no se encontraron diferencias en el rendimiento, tamaño de bulbo o fruto a causa de diferentes fuentes de fertilizantes en los chiles o cebollas. Un material de liberación lenta aumentó la absorción de N de las cebollas sobre el fertilizante que en mayor parte contenía NO_3^- pero esto no resultó en un efecto en el rendimiento. El calcio, azufre u otras substancias nutritivas disponibles mientras que el pH disminuía aparentemente no fueron limitantes. Uso eficiente de N aplicado fue bajo, indicando que gran parte del fertilizante N puede evolucionar a contaminante.**

Nitrogen is the primary plant nutrient limiting vegetable production in subtropical South Texas, and considerable effort and expense are focused on meeting this need. Studies have documented the need for N fertilizer for vegetables, and rates required for these conditions have been fairly well established (Pennington and Thompson 1982). Concern continues, however, that N nutrition may be limiting crop growth, so new N sources and application techniques are constantly being considered.

Nitrate (NO_3^-) is the form in which most N is taken up from the soil by roots, and is also the form most readily lost by leaching. Other soluble N forms used as fertilizers, urea [$CO(NH_2)_2$] or ammonium (NH_4^+) containing materials, may be utilized for improved availability and handling properties. These fertilizers are microbially oxidized to nitrate. Slow-release materials use various mechanisms to hold N against loss while gradually making it available for crop uptake. Slow release fertilizers are beneficial in vegetable production under some field conditions (Wiedenfeld 1986a, Wiedenfeld 1986b). Fertilizer acidity may provide side benefits by solubilizing nutrients whose availability is decreased at high soil pH levels.

This study was conducted to compare the effectiveness of various nitrogen fertilizers for irrigated vegetable production in the subtropical Lower Rio Grande Valley of Texas.

Materials and Methods

Two separate field studies wer conducted: one on Jupiter bell peppers (*Capsicum annuum*) in Starr County and the other on TG1015Y onions (*Allium cepa*) in Hidalgo County. The fertilizer materials tested (Table 1) were applied at a constant rate of N in each study: 105 lbs N/ac on peppers and 120 lbs N/ac on onions. The pepper field received a preplant "starter" fertilizer application containing 15 lbs N/ac, therefore a total of 120 lbs N/ac was applied at both locations. Fertilizer treatments were applied in randomized block designs with four replications in each field. Plots consisted of four, 40 in. rows, 50 ft. in length at both locations.

Measurements were taken to determine yields in the pepper crop, and to determine yield and N uptake in the onion crop. Pepper yields were determined by picking all peppers from a 20 ft. section of the middle of two rows of each plot on Nov. 26, 1990. Peppers were divided into size classes, counted and weighed. Onion N uptake was determined by taking plant samples on April 25, 1991, which were dried, ground and analyzed for total N by a procedure consisting of a wet acid digestion and analysis on a Wescon ammonia analyzer. Onion yields were determined on April 30, 1991, by harvesting and trimming all onions in the middle two rows, then counting and weighing by size class. All data were analyzed statistically by Analysis of Variance using SAS/STAT software (SAS Institute, Inc., 1988).

Standard cultural and management practices were utilized at both locations. Peppers were planted on July 18, 1990, with fertilizer treatments sidedressed on October 2, 1990, as the plants reached the 6-inch stage. Onions were planted on Oct. 15, 1990, and were fertilized on Dec. 5, 1990, following hand thinning. Pesticide applications, mechanical weed control and flood irrigation were applied as required on both crops.

Results and Discussion

Bell pepper yields and sizes showed no statistically significant differences due to the fertilizer N sources used (Fig. 1). Good pepper yields were obtained for this fall crop with most of the peppers falling in the large size class and less than 3% into the extra large (>3.5 in.) class. No apparent benefit was observed from having a large proportion of the N content as NO_3^- (Nitrocal), from inclusion of other nutrients such as Ca or S (Urocal, Nitrocal, Nitrosul) or from low pH (Formula). Since an unfertilized check was not included for the bell peppers, availability of residual N may have been adequate to meet crop needs.

Onion yields increased with N application over the unfertilized check, but again no signicant differences between fertilizer N sources were found (Fig. 2). All fertilized onions averaged about 0.6 lbs in size while unfertilized onions were less than 0.4 lbs. When compared to soluble N sources, there were no apparent advantages for slow-release mechanisms of for any of the other additional features provided by the materials tested.

Onion plant N concentrations and total N uptake also increased with N application over the unfertilized control, but fluctuated widely among fertilizer sources. (Fig. 3). The only statistically significant difference between sources was greater total N uptake by Nitroform than for Nitrocal suggesting an advantage for slow-release materials over a source having the highest percentage of its N as NO_3^-. This difference, however, was not reflected in yields. Nitrogen fertilizer use efficiency fluctuated between 15 and 30% for the seven materials tested on onions, and again was not statistically different among sources. This indicates that between 85 and 100 lbs of applied fertilizer N was unused.

Table 1. Fertilizer N materials evaluated on fall bell peppers and onions in the Lower Rio Grande Valley of Texas during 1990-91.

fertilizer	formulation	analysis	contents
urea	granular, soluble	46-0-0	$CO(NH_2)_2$
N-32	liquid, soluble	32-0-0	50% urea, 50% NH_4NO_3
Nitrocal	liquid, soluble	20-0-0-6Ca	25% urea, 12.5% NH_4^+, 62.5% NO_3^- (50% N-32, 50% $CaNO_3$)
Urocal	liquid, soluble	18-0-0-7	46% urea, 12% Ca
Nitrosul	liquid, soluble	20-0-0-45S	ammonium polysulfide $[(NH_4)_2S_3]$
Formula	liquid, soluble	9-0-0-12S	urea + H_2SO_4
Nutralene	granular, slow-release	40-0-0	methylene urea
Nitroform	granular, slow-release	38-0-0	ureaform (hydroxymethyl urea)
coated $(NH_4)_2SO_4$	granular, slow-release	32-0-0-12S	methylene urea-coated $(NH_4)_2SO_4$

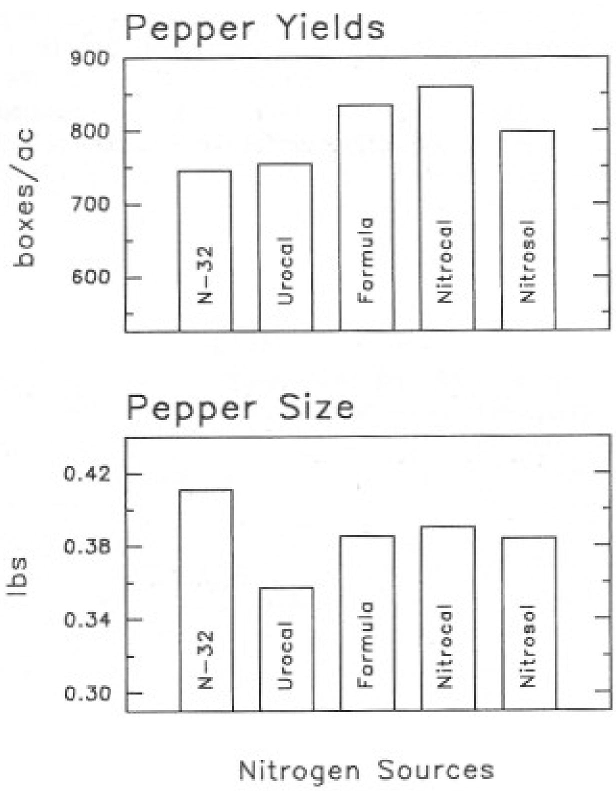

Fig. 1. Bell pepper yields (in 28 lb boxes) and sizes for the different N fertilizer materials used. Differences between means were not statistically significant.

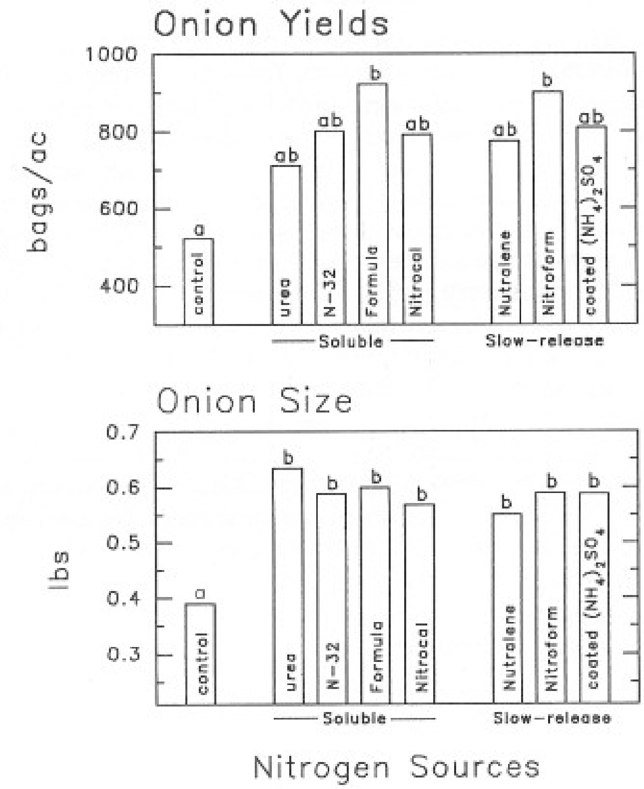

Fig. 2. Onion yields (in 50 lb bags) and sizes for the different N fertilizer materials used.

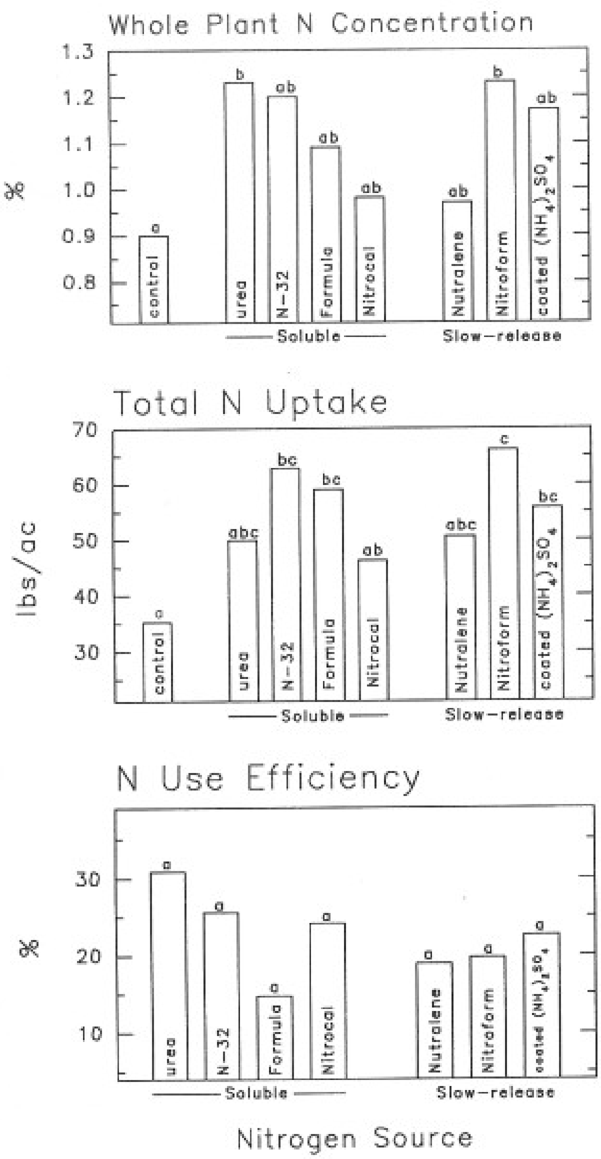

Fig. 3. Onion plant N concentration, total N uptake, and fertilizer N use efficiency for the different N fertilizer materials used.

Conclusions

Nitrogen was limiting on the onion crop, but may have been available in adequate amounts from soil residual for the bell peppers. Pepper sizes were good for all treatments (mostly large), but there was no unfertilized check. Once the crop N requirement was met from fertilization or from residual, there did not appear to be a substantial advantage for any of the various materials tested. More N was taken up in onions from a slow-release source than from a mostly NO_3^- source, but this did not benefit yields. Other nutrients such as Ca, S, or micronutrients whose availability increases as pH decreases apparently were not limiting production either, since the fertilizers that should have provided these benefits showed no particular yield advantage. Valley soils normally are not limiting in Ca and S, and the pH induced defficiencies occur only occasionally under certain circumstances. Responses to fertilizer formulation; however, are influenced by environment and may be somewhat different in other years. The low fertilizer use efficiencies found in this study suggest that much of the N applied was denitrified or leached and could potentially become a pollutant.

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