Nitrogen Release from Controlled-Release Fertilizers in Seepage-Irrigated Tomato Production in South Florida

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Introduction

Controlled-release fertilizers (CRFs) are soluble fertilizers encapsulated in resin, polymer, or sulfur-coated urea covered with a polymer. Manufacturers measure CRF nutrient release duration as 75% nitrogen (N) release at a constant temperature between 20 to 25°C. An increase or decrease in temperature will increase or decrease CRF N release. Thus, release from CRFs may be accelerated in the fall when soil temperatures in polyethylene mulched tomato beds can reach 40°C.

Objective

The purpose of this study was to evaluate N release duration of CRFs incubated in pouches under polyethylene-mulch covered raised beds and to determine the CRF duration suitable for incorporation into a fall tomato fertility program.

Materials and Methods

- On 15 Aug, 2011 raised-beds (76-cm wide and 20-cm high) were formed on Basinger fine sand in Immokalee, FL.
- Tomatoes were fertilized with a top and bottom mix containing 224 kg ha⁻¹ N, 49 kg ha⁻¹ P, and 400 kg ha⁻¹ K.
- Beds were fumigated and covered with white on black polyethylene mulch.
- Fiberglass mesh pouches (12.7 × 14 cm) containing CRFs ESN [Environmentally Smart N (44N-0P-0K)], 90 day release (DR)], D120U [Duration-urea (43N-0P-0K)], D120NPK [Duration-NPK (19N-2.6P-10.8K), 120 DR], and D180U [Duration-urea (43N-0P-0K), 180 DR] from Agrium Advanced Technologies Inc. equivalent to 3.5 g were buried 10 cm below the bed surface.
- Tomato cultivar BHN 726 was planted on 3 Sept. 2011 and grown using seepage irrigation.
- A data logger collected soil temperature 10 cm below the bed surface.
- Pouches were collected at eight dates during the season and ground in 300 ml DI water.
- N content was measured by combustion (AOAC 993.13) using an Antek 9000 N analyzer (Pac. Co., Houston, TX.).
- A nonlinear regression model (Equation 1) was fit to the data to determine N release rate. Equation 1. Percent N Release = a – (a-b) * e⁻ᵃ anda total N released (%)b=the intercept or N release when t=0c=release ratef=time (d)

Results

- Minimum, average, and maximum soil temperatures were 16.2, 26.1, and 40.1°C during the season (Fig. 1).
- ESN had the greatest N release rate compared to D120U, D120NPK, and D180U, which were not different. Nonlinear regression fit N release from all CRFs (R² = 0.94). The 75% CRF N release for ESN, D120U, D120NPK, and D180U was 41, 56, 57, and 59 DAP, respectively (Fig. 2).
- Season total N release for ESN, D120U, D120NPK, and D180U was 93.8%, 91.1%, 90.2%, and 91.5%, respectively (Table 1).
- The total N release measured (Table 1) and fit in the model (a value) (Fig. 2) were similar.

Conclusion

Nitrogen release from CRFs was accelerated due to high fall bed temperatures. Therefore, based on a one year study a CRF of 180 DR should be recommended for early fall plantings.

Table 1. Nitrogen (N) release from controlled-release fertilizers (CRFs) incubated in pouches during a 129 day tomato season during Fall 2011.

<table>
<thead>
<tr>
<th>CRF</th>
<th>Stated N release (days)</th>
<th>After bed placement (days)</th>
<th>After transplant (days)</th>
<th>Total N released (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESN</td>
<td>90</td>
<td>42a</td>
<td>26</td>
<td>93.8a</td>
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<tr>
<td>D120U</td>
<td>120</td>
<td>56b</td>
<td>42</td>
<td>91.1b</td>
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<tr>
<td>D120NPK</td>
<td>120</td>
<td>56b</td>
<td>40</td>
<td>90.2b</td>
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<td>D180U</td>
<td>180</td>
<td>56b</td>
<td>40</td>
<td>91.5b</td>
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<td>P-value</td>
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<td></td>
<td></td>
<td>0.0001</td>
</tr>
</tbody>
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References