Optimal Placement of Controlled Release Fertilizer for Seepage Irrigated Potato Production

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Abstract
Optimal placement of controlled release fertilizers (CRF, polymer coated urea) will reduce N application rates by increasing crop uptake efficiency and reduce the risk of nitrate leaching and/or runoff. Treatments were arranged in a factorial design consisting of three N rates (112, 168, and 224 kg ha⁻¹) and four fertilizer placements (banded 5 cm above seed, banded 5 cm below seed, mixed homogeneously throughout the row, and side-dressed in early emergence on one side of the row). With the lowest N rate, there were significant increases in total dry matter and total yield in the below-seed and mixed placement as compared with all other treatments. Placement of CRF below the seed piece could be a good approach that should be tested again under less soil salinity and/or higher N-stress conditions. The maximum nitrogen uptake efficiency (NUE) for fertilizer placement was exhibited by the banded treatments (above and below the seed). The NUE for the mixed treatment was significantly less than NUE for banded treatments. Results showed that placement of fertilizer below the seed piece could enhance dry matter accumulation early in the season as compared with sidedressed fertilizer placement. However, plants fertilized below the seed exhibited significant higher dry matter accumulation at full flowering than plants fertilized above the seed and mixed. The observed differences in dry matter accumulation at full flowering may be attributed to the combined effect of high N rate and enhanced fertilizer placement in the root zone.

Conclusions
A well-defined region of the potato root system can be used as a target zone to place fertilizers in order to increase nutrient uptake by precise placement.

Results and Discussion

Nitrogen uptake efficiency (NUE) for fertilizer placement was exhibited for the banded treatments (above and below the seed). The NUE for the mixed treatment was significantly less than NUE for banded treatments and the grower treatment (side-dressed) had the lowest NUE. Plants under the low N rate had the highest NUE while the grower treatment had the lowest (Table 2).

Introduction

Potato is a shallow rooted crop that is grown on sandy well-drained soils where rates ranging from 112 to 224 kg ha⁻¹ N have been recommended in the humid zone of the southeastern United States. Potatoes have been reported as a threat in the St. Johns River watershed in northeast Florida. Part of the problem is caused by farmers applying high rates of N as an insurance against yield reduction. Enhanced uptake is one of the proposed strategies to improve nitrogen use efficiency, restricting fertilizer rates as the same time. In the short term this could be accomplished by timely and precise placement of the fertilizer in root regions where it could be quickly absorbed by the roots. Controlled Release Fertilizers coated with polymers deliver nitrogen slowly by controlled diffusion, a process mainly governed by soil temperature and water movement. The maximum uptake of nitrogen occurs when the nitrogen release rate of the fertilizer is in balance with the nitrogen uptake rate of the crop. This is particularly important early in the season as the crop grows and can only be achieved when the fertilizer is placed as close as possible to the roots. A recent study by the University of Florida, Gainesville showed that placement of fertilizer below the seed piece could enhance dry matter accumulation early in the season as compared with sidedressed fertilizer placement. However, plants fertilized below the seed exhibited significant higher dry matter accumulation at full flowering than plants fertilized above the seed and mixed. The observed differences in dry matter accumulation at full flowering may be attributed to the combined effect of high N rate and enhanced fertilizer placement in the root zone.