NITRATE CONCENTRATION IN THE SOIL SOLUTION AS AFFECTED BY IRRIGATION WATER CONCENTRATION IN FERTIRRIGATION

TORQUATO MARTINS DE ANDRADE NETO[1]; EUGENIO FERREIRA COELHO[2]; JOSÉ ANTONIO DO VALE SANTANA[3]; EDVALDO BISPO SANTANA JUNIOR[3]; MARCIO DA SILVA ALVES[1].

[1] Graduate student. PRPG/UFRB/Cruz das Almas – Brazil e-mail: andradeneto@hotmail.com
[2] Researcher, PhD, CNPMF/EMBRAPA/Cruz das Almas – Brazil
[3] Undergraduate student. UFRB/EMBRAPA/Cruz das Almas – Brazil.

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ABSTRACT: The use of fertirrigation provides larger fertilizer application efficiency, reduction on labor and increases in the benefit-cost relationship to farmers. The inadequate use of fertilizer in fertirrigation by application of concentrated injection solutions may raise salt concentration in the soil solution increasing osmotic tension, reducing total soil potential, besides affecting ionic equilibrium in the soil solution. The work had as objective to evaluate three concentrations of urea and calcium nitrate in irrigation water on nitrate concentration in soil solution at two soil depths, considering banana crop grown in Yellow Latossol of coastal tableland. Treatments regarded about using of three calcium nitrate and urea concentrations (1.0; 2.5 and 4.0 g/l) in the irrigation water that was applied in the field by a drip irrigation system during the first cycle of banana crop. Samples of soil solution were collected every 15 days in each plot by water samplers that were installed at 0.30 m from the plant at depths of 0.20 and 0.40 m between two emitters. Nitrate concentration in soil solution increased with the increase of nitrogen source concentration in irrigation water. Mean nitrate concentration of soil solution for 4 gL^{-1} concentration of irrigation water was the largest one of both sources and soil depths.
KEW WORDS: soil solution, irrigation water concentration, sources of nitrogen

INTRODUCTION: The use of fertirrigation provides larger fertilizer application efficiency, reduction on labor and increases in the benefit-cost relationship to farmers. Fertirrigation allows total control on fertilizer application, considering time and amount to be applied to the soil. It is expect an appropriate fertilizer application in the soil in such a way that the ionic equilibrium be kept in the soil. However, it is possible a temporary occurrence of excess of salts or pH effects in the soil if fertirrigation is inadequately applied. The inadequate use of fertilizer in fertirrigation by application of concentrated injection solutions may raise salt concentration in the soil solution increasing osmotic tension, reducing total soil potential, besides affecting ionic equilibrium in the soil solution (Yeo & Flowers, 1989). As a consequence, root uptake will be affected. Nitrate is one of the inorganic ways of nitrogen and together with ammonium is the final product of mineralization of organic nitrogen. Nitrate is charged negatively and is not retained by soil particles. If it accumulates in soil solution it will move down during irrigation with percolation water resulting in leaching. In case of nitrogen application in the soil as fertilizer, nitrate leaching may raise the amount of these ions in groundwater that might be contaminated for human use and influence surface water resources affecting water quality (Dynia, 2006). One of the most important activities in fertirrigation management is the monitoring of ions in the soil solution where roots uptake nutrients. This task has been barely used mainly due to the lack of knowledge of farmers. It has been carried by soil sampling, by using soil solution water samplers or TDR technique. The work had as objective to evaluate three concentrations of urea and calcium nitrate in irrigation water on nitrate concentration in soil solution at two soil depths for banana crop grown in a Yellow Latossol of coastal tableland.

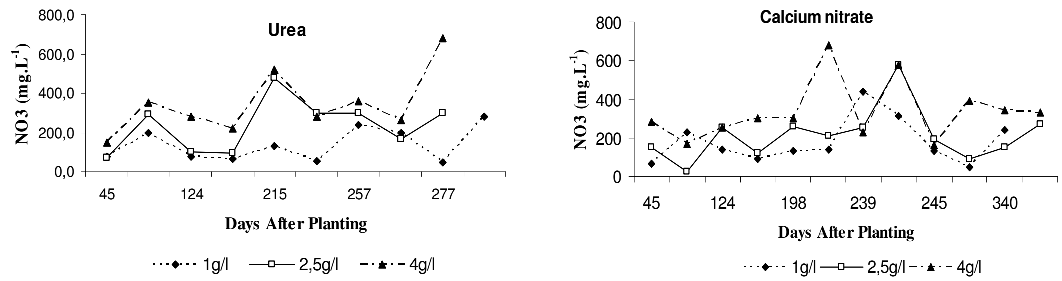
METHODOLOGY: The work was carried in a experimental field of Embrapa Cassava & Tropical Fruits, at Cruz das Almas city, Bahia State (12º48`S; 39°06`W; 225m), whose climate is classified as humid to sub humid with 1.143mm of rain per year (D`Angiolella et al., 1998). The soil chemical characteristics at the begining of the experiment were: pH 6.3; 11 mg/dm^3 of P; 0.06 cmolc/ dm^3 of K; 3.4 cmolc/ dm^3 of Ca+Mg; 0.09 cmolc/ dm^3 of Na; 1.32 cmolc/dm^3 of H+Al; 3.56 cmolc/ dm^3 of S; CTC 4.88 cmolc/dm^3; V 73% and M.O 5.01 g/kg). Treatments regarded about use of three calcium nitrate and urea concentrations (1.0; 2.5 and 4.0 g/l) in the irrigation water that was applied in the field by a drip irrigation system during the first cycle of banana crop. The experimental plots had six plants each. The drip irrigation system had one lateral line per plant row with three 4 L h^{-1} emitter per plant. Urea and calcium nitrate were used as source of nitrogen fertilizers and potassium chloride as source of potassium. They were applied at once a week. Calculation of amount of fertilizer of the injection solution followed recommendations of Borges et al. (2007). Samples of soil solution were collected every 15 days in each plot by water samplers that were installed at 0.30 m from the plant at depths of 0.20 and 0.40 m between two emitters, near plants. Soil solution samples were collected one day before and one day after fertirrigation event at three replications by using hand vacuum pump and were taken to laboratory for determination of nitrate using a kit for quick determination (cardy Horiba).

RESULTS AND DISCUSSION: There was effect of the nitrogen source on nitrate concentration at both depths. Also, there was effect of concentration of nitrogen source in the irrigation water on the nitrate concentration of soil solution for both depths (Table 1). Nitrate concentration of soil solution increased with the increase in concentration of nitrogen source in irrigation water. Mean nitrate concentration of soil solution for 4 gL^{-1} concentration of water irrigation was the largest one for both sources and soil depths. An interaction between nitrogen source and irrigation water concentration was verified when evaluating nitrate concentration in soil solution at different soil depths. When a concentration of 1.0 g L^{-1} of irrigation water by urea application was used, nitrate concentration in soil solution was smaller than nitrate concentration under calcium nitrate application at 0.20 m depth, but at 0.20 m depth nitrate concentration in soil solution was larger for urea application. When concentration of nitrogen sources in irrigation water were 2.5 gL-1 and 4.0 gL-1, nitrate concentration in soi solution under application of calcium nitrate was larger at 0.40 m depth and smaller at 0.40 m under application of urea. Concentrations of irrigation water equal or above 2.5 g L^{-1} have affect ion dynamics. Chemical reactions in the soil with urea application resulted in ammonium ions that were retained by soil particles (SILVA & VALE, 2000), giving less ions in soil solution compared to the application of calcium nitrate. In this case, nitrate ions were not retained by soil particles and moved down increasing concentration at 0.40 m depth.

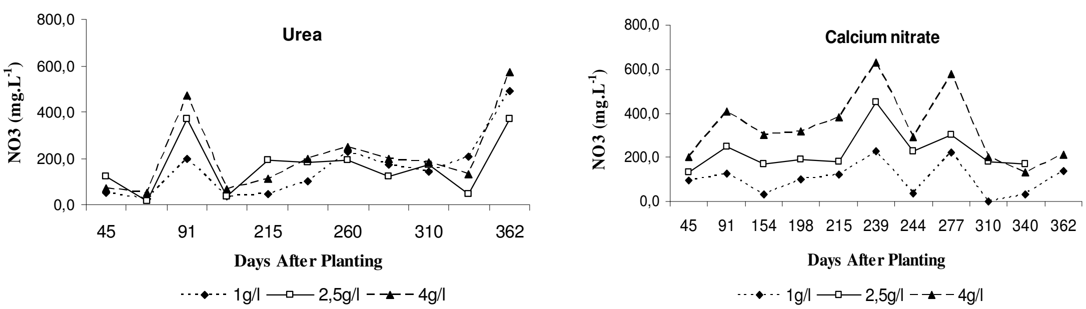
TABLE 1. Means of nitrate concentration in soil solution at depths 0.20 and 0.40 m as a result of application of three concentrations of urea and calcium nitrate in irrigation water.

Concentration	**NO3 mg.L^{-1}** (0.20 m)		**NO3 mg.L^{-1}** (0.40 m)	
	Urea	Calcium nitrate	Urea	Calcium nitrate
1.0 g/l	137,50 Aa	178,45 Ba	154,45 Aa	102,55 Ba
2.5 g/l	234,33 Bb	189,42 Aa	164,27 Aa	225,00 Bb
4.0 g/l	344,44 Bc	306,67 Ab	209,00 Ab	331,82 Bc

Figure 1 illustrates the evolution of nitrate concentration in the soil solution during the first cycle of banana crop. In accordance to Table 1, the largest nitrate concentrations in soil solution occured under application of 4.0 $g.L^{-1}$ of both nitrogen sources. The nitrate concentration values in soil solution under application of 2.5 and 4.0 g L^{-1} of urea in water irrigation at any time were more close each other than concentration values under 2.5 and 4.0 $g.L^{-1}$ of calcium nitrate. Values of nitrate concentration in soil solution under irrigation water concentration of 1.0 gL^{-1} for both sources and depths were within the range of values obtained by Monteiro (2007) who worked with spatial distribution of nitrate in a Yellow red Latossol. However, under irrigation water concentrations of 2.5 and 4.0 g L^{-1} the concentration values in soil solution were larger than the range obtained by the author (16 - 171 $mg.L^{-1}$).



(1a)



(1b)

Figure 1. Nitrate concentration in the soil solution at depths of 0.20 m (1a) and 0.40 m (1b).

CONCLUSION: Nitrate concentration in soil solution increased with the increase in irrigation water nitrogen source concentration. Soil solution nitrate concentration mean for 4 gL-1 water irrigation concentration was the largest one in all sources and depths. Nitrate concentration in sol solution was larger at depth of 0.40 m under aplication of calcium nitrate and larger at depth of 0.20 m under application of urea as nitrogen source for irrigation water concentrations of 2.5 and 4.0 gL^{-1}.

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