Development and validation of new fertilizers of high bioavailability and reduced nutrient losses: "Rhizosphere controlled fertilizers (RCF)"

Javier Erro[2], Roberto Baigorri[2], Oscar Urrutia[2], Angel M. Zamarreño[2], Jean-Claude Yvin[2], Jose M. García-Mina[1, 2]

[1] *Department of Chemistry and Soil Chemistry. Faculty of Science, University of Navarra, Spain;*
[2] *R&D Roullier Group (CIPAV, Pamplona, Spain; CRIAS, Dinard, France)*
jerrogar@hotmail.com

The development of highly efficient granulated fertilizers is of great importance to optimize the economical cost of each unit of fertilizer applied and to reduce the environmental contamination caused by nutrient losses. This study proposes a strategy that consists of developing specific fertilizers having nutrient release patterns that are dependent on plant activity in the rhizosphere, thus becoming more sensitive to plant nutritional needs. Therefore, the aim is to protect P from soil fixation and losses maintaining it bioavailable at the moments of plant uptake. This type of fertilizer is named "rhizosphere-controlled fertilizer" (RCF fertilizer). This fertilizer is based on the introduction of an organomineral matrix composed of humic-multimetal-phosphates (García-Mina, 2006). The presence of this matrix modifies the nutrient release pattern of the fertilizer. In this way there are two main nutrient fractions: (i) a water-soluble fraction or "starter" fraction and (ii) a "rhizosphere-controlled" fraction insoluble in water but soluble by the action of the rhizospheric acids released by microorganisms and plants, specially in nutrient demanding conditions. This study shows the chemical and structural characterization of the RCF organomineral matrix, as well as its efficiency in adapting nutrient fertilizer release rates to plant needs, principally with respect to P and N, which was directly correlated with the root release of rhizospheric organic acids (Erro et al., 2007; 2009, 2010). It is demonstrated that this RCF nutrient protection was also reflected in the significant reduction in nutrient losses concerning both ammonia volatilization and N leaching in a pot system study (Erro et al., 2007). Finally, pot experimental studies on the effect of RCF based P-fertilizers on the growth and P assimilation of wheat plants cultivated in alkaline-calcareous and acid soils showed the higher efficiency of RCF-P with respect to that of water-soluble P (simple superphosphate). This RCF-P higher efficiency was well correlated with those P soil fractions related to potential plant available P.

García-Mina, J.M. 2006 Fertilizing composition and process for the obtainment thereof. European. EP Patent 1,612,200.

Erro, J., O. Urrutia, S. San Francisco, and J.M. García-Mina. 2007. Development and agronomical validation of new fertilizer compositions of high bioavailability and reduced potential nutrient losses. J. Agric. Food Chem. 66: 7831-7839.

Erro J., A.M. Zamarreño, J.M. García-Mina, and J.C. Yvin. 2009. Comparison of the capacity of different phosphorus-fertilizer matrices to induce the recovery of phosphorus-deficient maize plants. J Sci Food Agric. 89: 927-934.

Erro J., A.M. Zamarreño and J.M. García-Mina. 2010. Ability of different water insoluble fertilizers to supply available phosphorus in hydroponics to plant species with diverse phosphorus acquisition efficiency: involvement of organic acid accumulation in plant tissues and root exudates. J. Plant Nutr. Soil Sci. In Press.