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Soil Potassium in Uruguay: Current Situation and Future Prospects

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Recent field research in Uruguay has revealed K deficiencies in the main field crops of the country. A preliminary survey indicates that almost 5 million ha would be deficient in K. A critical soil test K level (STK) of 0.34 meq/100g (133 ppm), has been estimated from 50 field trials.

Efforts to understand K dynamics in soils of Uruguay have been scarce compared with those for understanding N and P dynamics, which have been studied in different situations and cropping systems. Earlier studies in K response to fertilization were done for crops that have high-K requirements such as sugarcane, sugar beet, potato, onion, and cotton, for which some guidelines for fertilizer recommendations based on soil type were established. In grain crops, the first K studies were made in the 60's, and K responses were observed in wheat grown in soils developed from cretaceous sandstones. Two decades later, a few studies in soybean showed little or no K response in northeastern soils. The lack of K studies

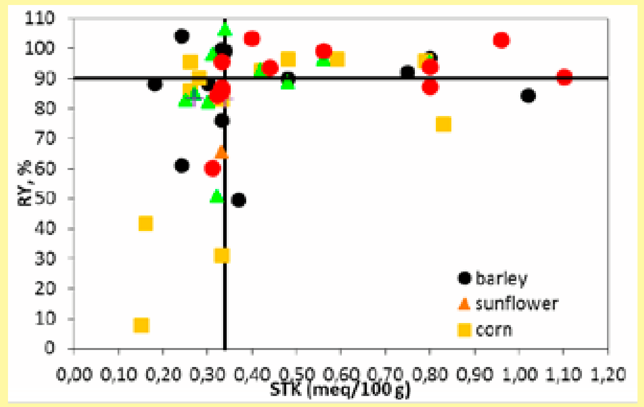

Fig. 1. Relationship between relative crop yield (RY) and soil test K (STK; 0-20 cm) in Uruguay. Based on data of 50 field experiments. RY expressed as the percent ratio between averaged yields of Check and Fertilized plots (100-200 kg/ha of KCl). Source: Barbazán et al. (2010, 2011).

in high K soils, under conventional tillage and crop rotations that included pastures, resulting in no K fertilizer recommendations. Potassium fertilization was recommended only below 0.30 meq/100g (117 ppm), following the references of US Corn Belt, which reported low K response probability with STK over 0.23-0.33 meq/100g (90-130 ppm) in soybean and maize under conventional tillage.

More recently, field research by the faculty of Agronomy (UdelaR), INIA, and other organizations reported some cases of K deficiency symptoms in soils with low STK in maize and Lotus corniculatus L.. Moreover, the increasingly occurrence of visual K deficiency symptoms, lead to more specific studies, which showed K response in several crops. A summary of 50 recent studies (which had the same tillage system, and similar experimental design, rate, and K source), found a critical STK level of 0.34 meq/100g (133 ppm; 0- 20 cm depth) (Barbazán et al., 2010; 2011), representing a breakthrough in K research in Uruguay (**Fig. 1**).

Soil K levels: Distribution and nutrient balances for Uruguay

Soils of Uruguay present a wide range of STK (**Fig. 2**). According to the Soil Survey Guide of Uruguay, soil units covering approximately 5 million ha would have low K availability. In the typical agricultural area of western Uruguay, STK is medium to high.

However, agriculture scenarios of Uruguay have

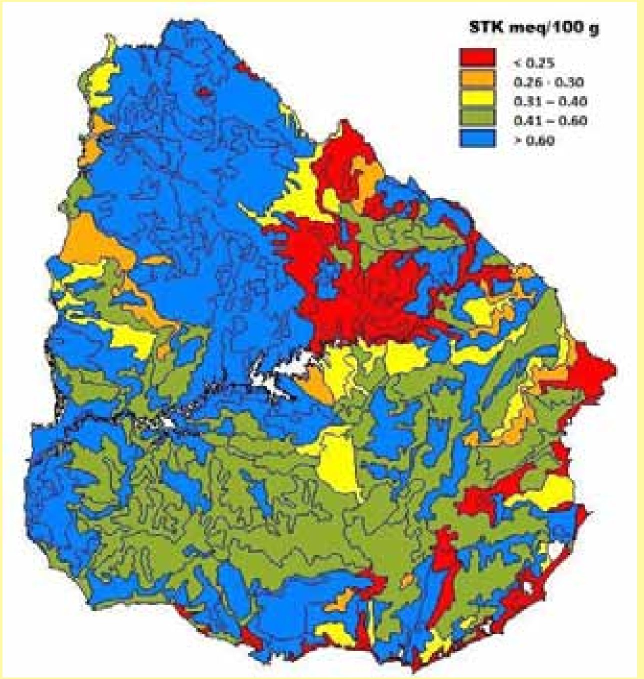

Fig. 2. Soil test K (STK; 0-20 cm) according to the soil recognition guide of Uruguay. Scale: 1:1,000,000. From Califra y Barbazán (unpublished).

changed during the last two decades: cropping systems have been intensified, showing a current index of 1.5 crops per year (DIEA, 2015), resulting in soil K depletion. In this sense, it has been reported that STK in soils under agriculture at Department of Soriano, in the western agricultural area, have decreased 40% and 44% at 0-7.5 cm and 7.5-15 cm, respectively, from the levels observed in the same soils without agriculture history. In addition, agriculture has expanded to marginal regions, where low STK soils are common.

The K balances in Uruguay (application minus removal), have historically been negative due to the absence of K fertilization (Mancassola and Casanova, 2015). Moreover, as soybean has increased in area (**Fig. 3**), due to its high K requirements, K balance has become more negative; i.e., soybean production for 2012 was of 2.76 M t, implying a K removal of approximately 55,000 t of K_2O considering an average grain content of K.

Understanding soil K dynamics is a priority to define research areas that produce useful information for K management, considering the large agricultural area, and the dependence of imported K fertilizer, moreover

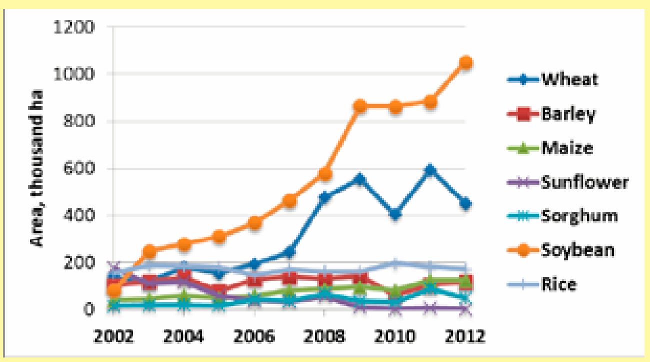

Fig. 3. Cropped area by the seven main crops in Uruguay during the 2002-2012 period. Based on DIEA (2015).

of their current prices in Uruguay. Agronomists and farmers are already concerned about STK in the different regions, as reflected by the increasing soil K analysis demand.

Soil K removal has grown with soybean production, which currently covers approximately 1 million hectares through a wide range of soils with different availability and stocks of K. Quality and management of crop residues, may affect K distribution with soil depth, and it should be considered by soil survey/sampling and fertilizer recommendations.

Current research and experimentation focus on the relationship of K dynamics with soil mineralogy and physical properties, and changes in cropping systems and soil management history in the medium and long term. These studies would be useful to develop K fertilization guidelines. Potassium use efficiency depends on understanding of K dynamics in the soil-plant system, as well as crop and soil responses to soil fertility management. Long-term studies would greatly contribute to finding solutions to existing and anticipated problems.

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Balancing K use in Cereals through Nutrient Expert®: Improved Yield, Higher Profit, and Reduced GHG Emission

Sudarshan Kumar Dutta, Kaushik Majumdar and T. Satyanarayana

Inadequate and imbalanced application of nutrients, especially of K, by the cereal growers of India leads to less crop productivity and foodgrain production of the country. One of the major reasons of this drawback is associated with the lack of recommendation protocol suitable for small-scale resource challenged farmers. Nutrient Expert® (NE) provides balanced fertilizer recommendation suitable for varied yield target and farmer resource availability. The recommendation from NE guides farmers to apply the required amount of K along with other nutrients to increase productivity, enhance economic benefit and reduce green house gas emission from farm fields.

The fertilizer consumption in India has increased significantly since last four decades. The Total NPK (N, P_2O_5, and K_2O) consumption increased twelve times, from nearly 2 million to 25.5 million tonnes between 1969-1970 and 2011-2012 (FAI, 2014). However, there was a disproportion of the consumption ratio among these nutrients. Nitrogenous fertilizer accounted for nearly 66 per cent of total nutrient consumption in the country (Majumdar et al., 2014); while P_2O_5 and K_2O shares were only 26 and 8 per cent, respectively (FAI, 2014). This is a serious concern particularly in cereal-based cropping systems where removal of K is equal to or more than N. Inadequate K application results in a negative input-output budget