Agricultural gypsum application in soils with of sodium: study in microlysimeter

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INTRODUCTION

Excess sodium ions (Na) in the cation exchange complex affecting negatively the crop development. The highly hydrated nature of the Na ions inhibits the flocculation of aggregates and causes a high dispersion of soil colloids. In Uruguay, the origin of excess of Na in soils is natural.

The soils with excess Na in the exchange complex are remediating by the apply gypsum.

The objective of this study was to evaluate in microlysimeter the effect of the application of agricultural gypsum in a soil with excess Na, under controlled humidity and temperature.

METHODOLOGY

For this research, was used of the Ap horizon of a soil with excess of Na located inside the field of Mario A. Cassinoni Experimental Station (EEMAC) of the Agronomy Faculty of Universidad de la República (Paysandú, Uruguay). On each microlysimeter was added soil mixed with doses equivalent to 3 000 and 6 000 kg ha-1 of two agricultural gypsum from different companies (Source A and Source B) and was left a control (without gypsum). Each treatment was replicated three times. Were made periodic leachates, with 100 mL of deionized water added gradual and homogeneously through the use a diffuser for adequate moistens the system. The soil of the microlysimeters was maintained at field capacity, with the addition of deionized water every 15 days.

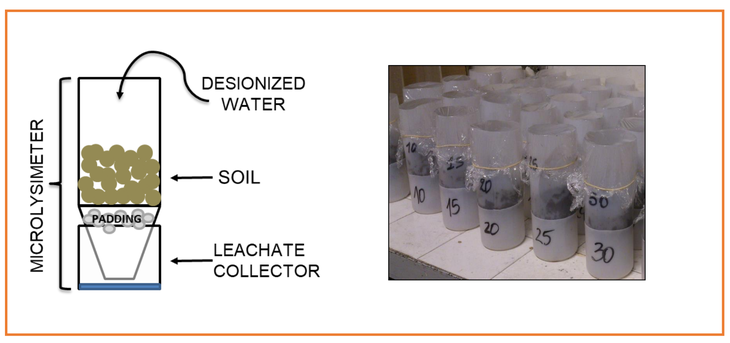

Fig 1. Detailed diagram of the microlysimeter assembly, location of soil and leachate collector.

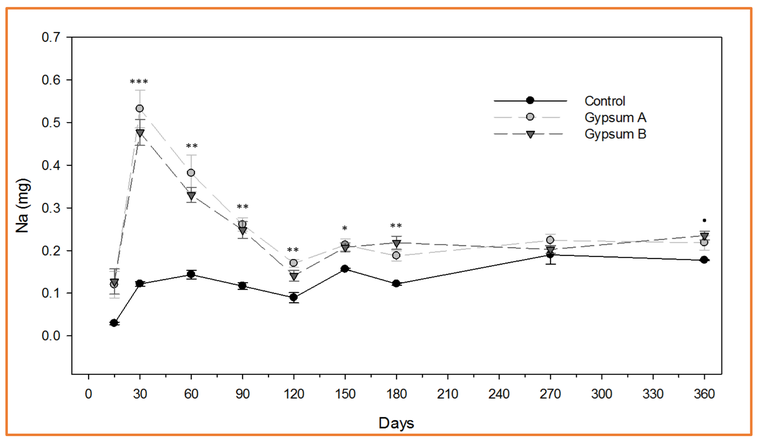

Fig 2. Variation of sodium content displaced from the soil in function the collection moment of leachate water. The interaction between treatments is represented by *** P < 0.001; ** P < 0.01; * P < 0.05; • P < 0.1..

RESULTS

The Na displaced from the soil by Ca was graphed (fig 2) a function of collection moment of leachate water. During the first 30 days of treatments was observed highest displacement measured as Na content, and after 120 days decreasing to almost equal the control treatment.

The gypsum is a soluble material so largest replacement of Ca ion by Na ion in soil cation exchange complex occurs in first cycles of leachate. The results of Qadir et al. (1996) agree that the greatest loss of Na ion occurs during the first leaching.

The Na exchangeable of the soil decreased by 35% when comparing initial value with obtained at the end of experiment (table 1). There was no significant difference in the effect of Na decrease between applied doses neither between sources agricultural gypsum. However, there was significant difference between the treatments and the control (22% less Na exchangeable in the soils with gypsum compared to control).

The effect of gypsum application on physicochemical properties is long-term. The decrease in concentration Na and ESP occur in soils that were under treatment for a longer period of time. This is due to fact that the exchange of Ca by Na is a complex and continuous process, so effectiveness of gypsum is directly related to time of experimentation (Arévalo et al., 2009, Mao et al. 2016).

Table 1. Exchangeable Na concentration and exchangeable sodium percentage (ESP) in soil with gypsum treatment microlysimerter, there was no distinction between doses and source of gypsum (excluding control). Mean values with different letters in a column differ significantly according to Tukey HSD test for means at P < 0.05.

Days	Na (cmol kg^{-1})	ESP (%)
0	1.53a ± 0.28	14a ± 0.3
90	1.36a ± 0.05	9b ± 1.1
180	1.12b ± 0.15	7c ± 1.1
360	0.99c ± 0.10	6c ± 0.7

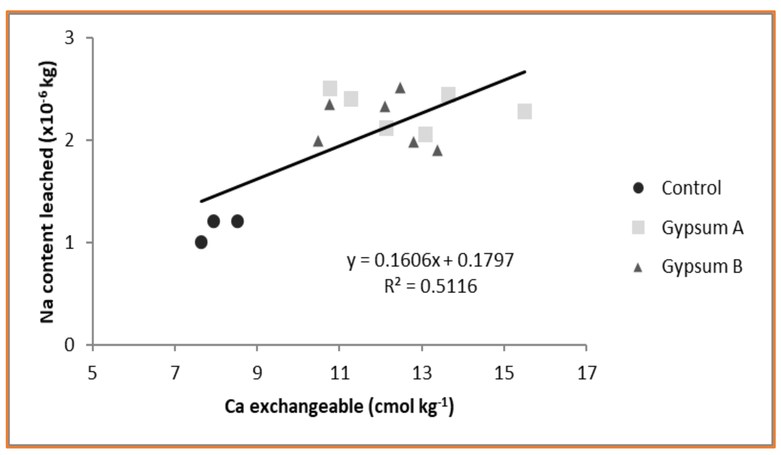

Fig 3. Correlation between Na displaced in leachate with concentration of exchangeable Ca in the soil after 360 days gypsum aplication. There are a correlation index (Pearson) of 0.80 was established, with a linearly positive relationship.

A linear and positive correlation (Pearson's index 0.80) was established between total Na content displaced from the soil in leachate water and Ca exchangeable present in soil, after 360 days of treatments application (fig 3).

Therefore, the higher concentration of Ca applied with the gypsum the greater the amount of ions Na displaced during leaching (Mahmoodabadi et al., 2013).

CONCLUSIONS

The agricultural gypsum used were effective for the displacement of the Na ion exchange complex in soil with excess Na of natural origin, such as the one present in this study.

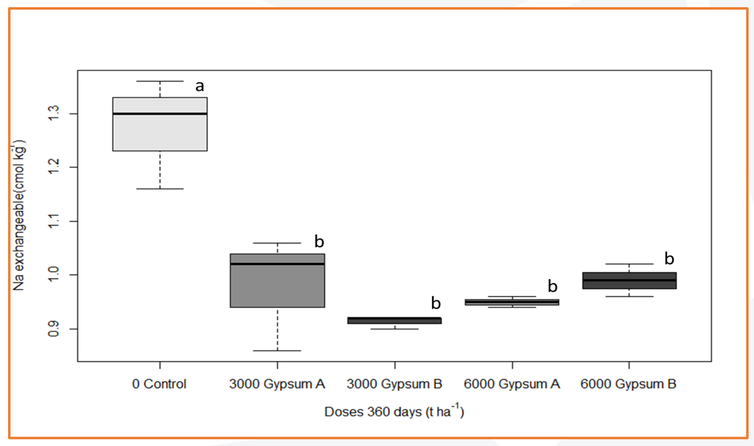

Fig 4. Concentration of Na exchangeable after 360 days gypsum application (source: A and B) and control (without gypsum). 3 000 and 6 000: equivalent doses to 3 000 and 6 000 kg ha-1 of agricultural gypsum. Boxes with different letters (a and b) means significant difference according to Tukey HSD test for means at P < 0.05.

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