Accepted Manuscript

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PII: S1002-0160(17)60380-1
DOI: 10.1016/S1002-0160(17)60380-1
Reference: NA

To appear in:

Received date: NA
Revised date: NA
Accepted date: NA

Please cite this article as: Akram FATEMI, Kinetics of Soil Potassium Release under Long-term Imbalanced Fertilization in Calcareous Soils, *Pedosphere* (2017), 10.1016/S1002-0160(17)60380-1.

PEDOSPHERE

Pedosphere ISSN 1002-0160/CN 32-1315/P doi:10.1016/S1002-0160(17)60380-1

Kinetics of Soil Potassium Release under Long-term Imbalanced Fertilization in Calcareous Soils

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ABSTRACT

The kinetics of potassium (K^+) release under continuous fertilization with urea and triple superphosphate without K^+ was investigated in chloritic and kaolinitic soils. The kinetics of K^+ release from the soils in the N and P treatments was also studied in order to compare the obtained results. The results showed that the kinetics of K^+ release included an initial reaction and a slow reaction. The phosphate- and ammonium-induced K^+ release followed the same rate process during initial (2 – 192 h) and (192-1090 h) reaction periods. There were no significant differences between cumulative K^+ released amount from chloritic and kaolinitic soils among all treatments. The cumulative K^+ released was correlated positively with P adsorption capacity for chloritic (r = 0.461, $P \geq 0.05$) and kaolinitic soils (r=0.625, $P < 0.01$) and negatively with fixation potential for chloritic (r = 0. 720, $P < 0.01$) and kaolinitic soils (r= -0.513, $P < 0.01$). There was a significant ($P < 0.001$) interactive effect of fixation potential × P adsorption capacity on cumulative K^+ released amount for both soil groups. Initial rate release (IRR), for chloritic soils were significantly ($P < 0.05$) more under P and NP application. The IRR followed the order as: NP=P > N=C for chloritic and N=P > NP > C for kaolinitic soils. This study showed that the fixation of ammonium and P adsorption capacities control K^+ release from soils. This information could be helpful for the precise fertilizer recommendation for the studied soils.

Key Words: fixation potential, initial release rate, mineralogy, P adsorption capacity, triple superphosphate, urea

INTRODUCTION

Nutrient management is a key challenge for global food production amongst which the increase of nutrient availability for crop production in small farms is one of the most important priorities in developing countries (Powlson *et al.*, 2011). Although that calcareous soils of Iran have considerable native quantities of potassium (K^+), with conventional cropping and without any K^+ fertilization the cropping system would not be sustainable (Hundal and Pasricha, 1998). K^+ as an essential element for plant growth can be divided into water-soluble, exchangeable, nonexchangeable and mineral phase (Martin and Sparks, 1985). Various there are dynamic equilibrium reactions between different forms of K^+ are known to exist, while the nonexchangeable K^+ can be an important reservoir of K^+ in soils. Since plants use different proportions of nonexchangeable K^+, exchangeable K^+ is not always a reliable method of bioavailable K^+ determination (Jalali, 2006). Besides, availability of nonexchangeable K^+ is not dependent on the quantity of interlayer K^+, but also on the release rate from the mineral phase in the soil. Hence, a comprehension of K^+ release dynamics from all four K^+ phases of is important to develop and recommend efficient and profitable K^+ fertilizer application (Sparks and Carski, 1985). Numerous studies have been conducted on the kinetics of