The role of biosolid derived compost on cation exchange

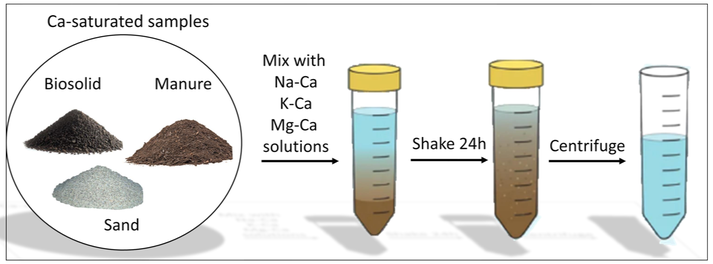
Thao Bich Nguyen, Gilboa Arye (bichthao@post.bgu.ac.il)
French Associates Institute for Agriculture and Biotechnology for Drylands, Jacob Blaustein Institutes for Desert Research, Ben Gurion University of the Negev, Israel

Introduction

- In agricultural soils, organic matter (OM) plays a vital role in biogeochemical processes, particularly through nutrient availability and soil structure stability as influenced by cation exchange processes.
- The decline of OM represents one of the most serious threats facing many arable lands of the world. An efficient approach to increasing OM content is the application of organic amendments such as compost, biosolids and livestock manure.
- However, the intrinsic properties of soil OM in conjunction with cation exchange processes have not been thoroughly investigated.
- The objective of this study is to quantify competitive cation exchange in pure biosolid, manure and mineral soil.

Methodology

Batch exchange experiment



Gapon selectivity coefficient (K_G)

Gapon equation for Na-Ca exchange reaction:

$$Ca_{½}X + Na^{+} \leftrightarrow NaX + ½Ca^{2+}$$

K_G is calculated:

$$K_{G(Na\text{-}Ca)} = \frac{E_{Na}\,(Ca^{2+})^{1/2}}{E_{Ca}(Na^{+})}$$

Equivalent fractions of adsorbed Ca and Na:

$$E_{Ca} = \frac{2[CaX_2]}{2[CaX_2]+[NaX]}$$

$$E_{Na} = \frac{[NaX]}{2[CaX_2]+[NaX]}$$

Results

	pH	EC dS/m	Na	K	Ca	Mg	DOC	TN	CEC	OM	C	N
			mg/L						meq/100g		%(w/w)	
Biosolid	8.4	10.2	381	969.5	99.35	44.75	572.1	137	38.15	30.4	14.8	1.7
Manure	8.13	11.7	410.5	1179	103.5	37.9	403.4	129.3	30.81	23.5	16.78	1.85

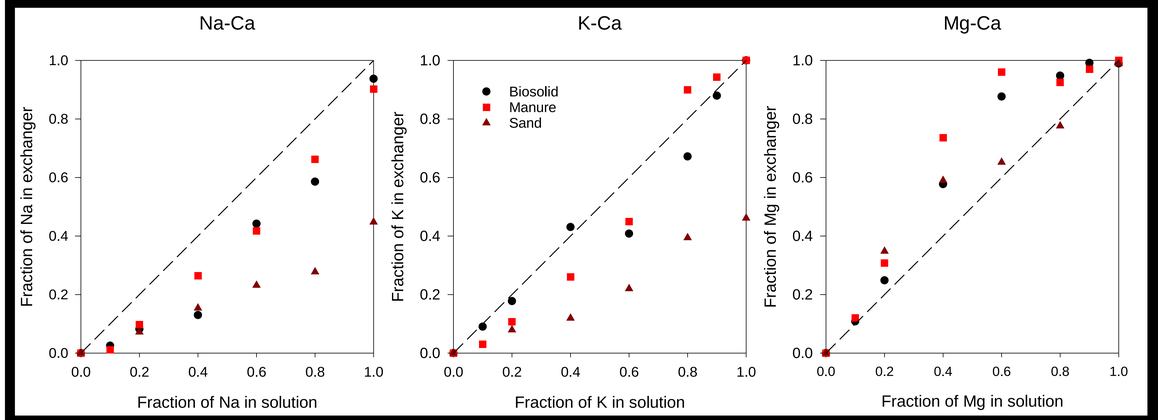


Figure 1. Exchange isotherm of Na-Ca, K-Ca, Mg-Ca in biosolid, manure and sand.

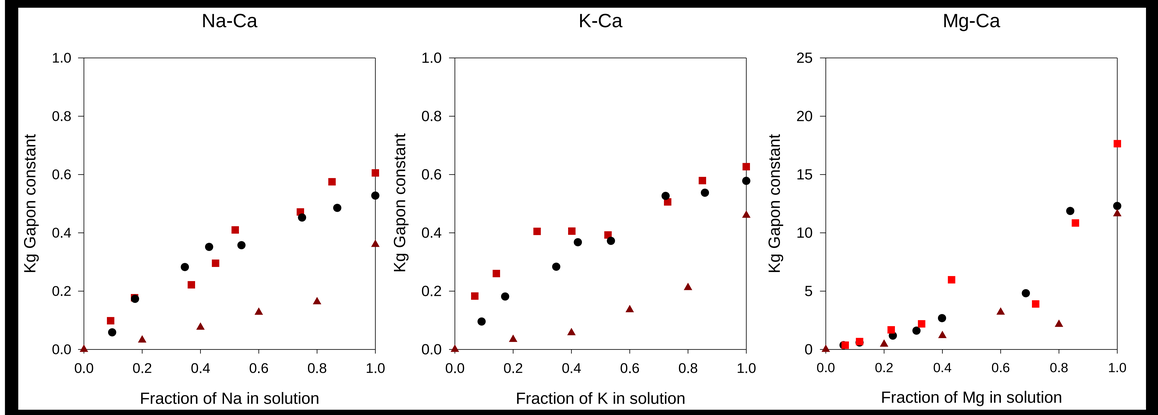


Figure 2. Gapon selectivity coefficient for Na-Ca, K-Ca, Mg-Ca in biosolid, manure and sand.

Conclusion

- The mineral sand showed no preference between Ca and Mg, but highly favored Ca over K and Na as classical lyotropic series based on ionic strength, valence and hydrated ionic radius.
- The biosolid and manure showed an affinity for cation exchange processes not following the lyotropic series, as arranged by this order: Mg > Ca ≥ K > Na.
- The change in selectivity of K over Ca is observed, indicating the existence of exchange sites having specific preference for K in biosolid.