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Phosphorus availability in the tropical soils of Reunion – Comparison of various methods

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Objectives
Application of organic waste is expected among other beneficial effects to enhance phosphorus (P) availability in soils, but this fertilizer effect largely depends on soil properties [1]. Phosphorus availability in the soils of Reunion (a French tropical island in the Indian Ocean) has been poorly studied [2]. Despite a similar volcanic origin, these soils are expected to exhibit very different P availability due to their distinct pedogenetic evolutions. Accordingly, the aims of this preliminary study are i) to determine P availability in a wide range of soils of Reunion supplied or not with various mineral and organic fertilizers and ii) to evaluate the relative relevance of different soil P tests and their respective correlation with P uptake in various crops (phytoavailability).

Methodology
Fifty soil samples were collected in 5 field trials, encompassing the main soils types (i.e. hydric andosol, chromic andosol, andic cambisol, nitisol and hyperskeletal fluvisol), and cropping systems (fodder, sugar cane, market garden crops) of Reunion.
Phosphorus availability in soil samples was measured with 4 chemical methods: i) CaCl2 (0.01M) extraction to mimic soil solution ii) DGT (diffusive gradient in thin films) technique to estimate the diffusive and kinetically-labile pools and iii) the Olsen (0.5M NaHCO3 at pH 8.5) and Olsen-Dabin (0.6N NaHCO3 + 0.6N NH4F at pH 8.6) extractions that respectively target the moderately and weakly available pools.
Phosphorus concentration in shoots was then measured on plant digests by ICP-MS.

Results
Available P is expected to vary highly with both soil types and the chemical method used. Phytovailability P is further expected to vary between crop species.
The analysis of data distribution will highlight the capacity of each chemical method to discriminate the soils tested. The search for correlations between chemical methods could then reveal differences or similarities between results obtained with the different methods. Linear regressions of phytovailable P against soil available P and comparison of the coefficient of determination obtained between each chemical method will highlight the efficiency of each soil P test to reflect phytovailability P. With some methods, available P is expected to be correlated with P uptake in most of the soils tested, while it could be correlated just in some soil types with others, such as Olsen-Dabin extraction, which is known to extract a large pool of P weakly available.

Conclusion
Olsen-Dabin extraction, which is the traditionally soil P test used in Reunion to fit P fertilization to crop requirements, is expected to be unsuitable for tropical soils such as those of Reunion [3]. One other method able to distinguish P availability as a function of soil types and fertilization management and more closely related to P phytovailability will be selected and further used to discriminate the respective contribution of soil types and organic fertilization on P availability in soils.

References