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A simplified extraction schema to for the analytical characterization of apple orchard soils

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In agriculture, soil analysis is mainly done to monitor available nutrients as well contaminants, in order to find the optimum fertilization resp. remediation strategy. Traditionally, available nutrients in soils have been obtained from a series of different extractions, some just for one single parameter. In order to simplify the entire procedures, multi-element techniques, like ICP-OES and ICP-MS, have been applied to a sequence of extracts obtained with 0,16M acetic acid and 0,1M oxalate buffer pH 3, which are more suitable for the plasma than traditional salt extractant solutions. Dilute acetic acid should characterize exchangeables plus carbonates, and oxalate buffer the pedogenic oxides. Aqua regia extractions in glass have been replaced by pressure digestion with $KClO_3$ in dilute nitric acid, which yields results equivalent to aqua regia, and additionally permits the determination of total sulfur, as well as acid-leachable boron and silicon. Total digestion was done in PTFE beakers by fuming with HNO_3/HClO4, subsequently with HF, and final uptake in 1+1 HCl. The results of total digestion could be verified by XRF analysis of the solid, Ti recovery was the most critical item.
The method was applied to 34 soils from apple orchards of different soil types and climatic zones. P and K obtained from standard acetate-lactate extract as well as B obtained from the Baron extract correlated with the results from the acetic acid extract better than 0,9. Just Mg from the CaCl2 extract (Schachtschabel) was independent from all other Mg fractions. The results for Ca, Cu, Mg, Mn, Sr, Pb and Zn obtained from $KClO_3$ digest and from totals, were strongly correlated. The Rare Earth elements formed a strongly intercorrelated group as well after total digestion as in the oxalate leach. Factor analysis was utilized to prove if the obtained fractions part into groups in a geochemically feasible way. The fraction mobilized by dilute acetic acid contained Ca-Mg-carbonates as well as the minority elements Al-B-Ba-K-Na-S in the first factor, whereas Fe-Mn-Ti-La-Li-Sr-Y formed a group of its own. Both groups were rather independent from nutrient P as well as from the pedogenic oxides, obtained from Al-Fe-Mn-Ti released in oxalate. The oxalate soluble fraction was independent form available nutrient levels, and parted into 5 groups, of which one contained the anions B-S-Si, another one the contaminants As-Cd-Pb.
Finally, the relations of these soil data to apple leaves from May and August, apple blossom leaves and apple fruits grown at these sites will be discussed, covering 50 varieties.
The proposed method permits to obtain informations about common cations including trace elements, and the non-metals phosphorus, silicon, sulfur, boron and iodine simultaneously, which could be a gate to find new relations among them.