

Studies on the availability of phosphorus

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There are a plenty of investigations that are dealing with the efficiency of the methods usually used for extracting what is so-called available soil P. However, a great number of the investigators tried to relate the available fraction of soil P to the different characteristics of soil, and hence, developing methods of extraction restricted to each type or category of soils. This work, briefly, aims to test and compare the reliability or efficiency of the important methods and parameters usually used for assessing soil P availability to plant. Thus the follow-ing analyses and trials were undertaken: (i) Direct extraction of soil available P by means of: 1). The classical method of Olsen (Olsen et al. 1954) and that modified by Colwell (Colwell 1963). 2). Distilled water at three soil:water ratios namely; 1:5, 1:60 and 1:250. 3). Sr-citrate method (0.02 M SrCl_2 + 0.05 M citric acid). 4). CaCl_2 solution (0.02 M CaCl_2). 5). NH_4F + HCl (Bray-1 and Bray-2). 6). AER (Dowex AG type 1 X 8 mesh 20-25, Cl-form). 7). ^{32}P exchange technique. (ii) Soil P fractionation. (iii) Sorption relations of P in soils. The aforementioned trials were conducted using 39 surface soil samples collected from different sites throughout the Nile Valley and Delta as well as those taken from the northern coast and Sinai. The collected soil samples were grouped to represent 4 soil categories, namely; calcareous ($>7\%$ CaCO_3), noncalcareous (, 7% CaCO_3), heavy textured ($>40\%$ clay) and light textured soils ($<40\%$ clay) and were subjected to routine chemical and physical analyses as well as the aforementioned specific determi-nations and relations. Stepwise regression analysis was also run by introducing the values of different P fractions in combination with the different soil characteristics (as independent variables) with plant P uptake (as a dependent variable). The obtained results could be summarized as follows: (1). With respect to the tested soils as a whole, the Colwell method was proved to be the most efficient method for assessing soil P available to rye plants ($r = 0.830$). In the same respect, the other investigated methods could be arranged descendingly according to the "r" val-ues in the following order; AER ($r = 0.803$) $>$ H_2O 1:5 ($r = 0.797$) $>$ Olsen ($r = 0.775$) $>$ CaCl_2 ($r = 0.746$) $>$ H_2O 1:60 ($r = 0.610$) $>$ ^{32}P -exchange technique ($r = 0.607$) $>$ H_2O 1:250 ($r = 0.557$) $>$ Sr-citrate ($r = 0.556$). (2). The highest degree of correlation ($R = 0.912$) was achieved by introducing the values of available P extracted by Colwell method in combination with values of water-soluble P fraction extracted at 1:5 soil: water ratio, Sr-citrate extractable P fraction and the organic P fraction together versus plant P uptake in multiple regression analysis and the relation obtained was repre-sented by the equation: $\text{P-uptake} = 2.880 + 0.296 \text{H}_2\text{O-P (1:5)} + 0.060 \text{Sr-citrate-P} + 0.023 \text{Colwell-P} + 0.007 \text{organic-P}$. However, "R" values for the other combinations; $\text{H}_2\text{O P (1:5)} + \text{Colwell-P}$ and $\text{H}_2\text{O-P (1:5)} + \text{Sr-citrate-P} + \text{Colwell-P}$, were 0,861 and 0.882, respectively. (3). Concerning the reliability of the studied methods used for extracting P within the different soil categories, the Sr-citrate method was the most suitable one in pre-dicting plant P uptake in the noncalcareous soils ($r 0.710$). The relation obtained was represented by the equation; $\text{P-uptake} = 2.664 + 0.083 \text{Sr-citrate-P}$. In the calcareous soils, the Colwell method was the most reliable ($r = 0.926$, $\text{P-uptake} = 2.895 + 0.031 \text{Colwell-P}$), and in the heavy textured soils ($>40\%$ clay), the AER method was the most suitable one ($r 0.934$) and the relF.tion between the AER-P and P-uptake could be represented by the equation; $\text{P-uptake} = 1.498 + 0.091 \text{AER-P}$. However, in the light textured soils ($<40\%$ clay), the distilled water at the soil:water ratio (1:5) was the most suitable for predicting plant P uptake ($r = 0.710$) and the relation was represented by the equation; $\text{p-uptake} = 3.856 + 0.623 \text{H}_2\text{O-P (1:5)}$. (4). Regarding the different P fractions dominating in the investigated soils, the following descending order was achieved: $\text{Ca-P} >$

occluded-P > Fe, Al-P.(5).Concerning the relationship between the aforementioned P fractions and plant P uptake, Fe, Al-P fraction significantly correlated with P-uptake by rye plants ($r = 0.438$). This trend was obvious in the calcareous ($r = 0.751$), heavy textured ($r = 0.762$) and light textured soils ($r = 0.511$). However, no significant relation was achieved, in this concern, in the noncalcareous soils.(6).Occluded-P could serve also as an important fraction of available P in such alkaline soils as it related to P-uptake at a high level of significance ($r = 0.504$). The "r" values achieved for the calcareous soils and the light textured ones were 0.769 and 0.420, respectively.(7).Calcium P fraction, the most dominant fraction in the investigated soils, did not correlate significantly with P-uptake by plants, except in the noncalcareous soils where a highly significant relation was obtained ($r = 0.620$).(8). With respect to P adsorption parameters calculated from Van Huay equation, no significant relationship was found between P-uptake by rye plants and both of the P-max. and affinity constant in the noncalcareous and calcareous soils. However, a highly significant, but negative, relationships were achieved for the heavy textured soils between P-uptake and both the P-max. ($r = -0.765$) and affinity constant ($r = -0.676$). In contrast, for the light textured soils, a positive correlation was achieved between values of the affinity constant and P-uptake ($r = 0.383$).(9). Regarding the corresponding parameters calculated from Langmuir isotherm i.e., K_2 (max. P adsorption) and $1/C_1$ (bonding energy), no significant relationships with P-uptake could be detected in the different soil categories, except the light textured soils where a significant and positive relationship was obtained with the max. P adsorption ($r = 0.465$) and also a significant but negative relationship with the affinity constant (K_i) was achieved ($r = -0.455$).