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Short Communication

Phosphate Buffering Capacity and Supply Parameters Affecting Phosphorus Availability in Vertisols

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Phosphorus availability to plants has been variously correlated with the soil P supply factors of quantity, intensity and buffering capacity. The underlying cause of the differing importance of quantity, intensity or buffer capacity to P availability is probably the relative effect of these factors on the diffusion of P. Phosphorus is primarily transported to the root surface through the process of diffusion (Wild 1981). Olsen and Watanabe (1963) estimated on the concentration of P in the soil solution (intensity), the ability of the soil to replenish solution P (*i.e.* buffer capacity and the diffusion coefficient of P in soil).

Khasawneh (1971) stated that quantity, intensity and buffering capacity of soils determine the supply of P to growing roots of plants. Khasawneh and Copeland (1973) advocated the use of a "supply parameter" which combines the effect of above factors in predicting the availability of P to plants. In a greenhouse study, the total P removed by rice and wheat was found to be correlated significantly with the phosphorus supply parameter and cumulative release of phosphorus in three soils differing in soil characteristics (Singh & Sarkar 1985). From these observations it can be inferred that P availability can be governed by intensity, quantity, buffer capacity and supply power, either singly or in combination, depending on the relative variation of these factors in the suits of soils used. The aim of the present investigation is to determine the P supplying capacity of soils in terms of buffering capacity and supply parameter in an attempt to further improve the soil test procedure for assessing the phosphorus status.

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Four surface soils were collected from three benchmark soil series. Processed soil (< 2mm) were used for the experiment. Some characteristics of these soils are given in table 1. The phosphate adsorption

Table 1. *Some characteristics of the Vertisols studied*

Soil series	pH	Clay (%)	$CaCO_3$ (%)	Olsen-P (mg kg^{-1})	Total-P (mg kg^{-1})
Kasi reddipalle (BR-1)	8.4	53	6.1	2.2	150
Kasireddipalle (BW-6)	8.5	52	5.2	3.5	250
Barsi	8.6	61	11.1	2.1	325
Begamganj	8.0	48	2.4	7.4	406

characteristics of the soils, were determined by using the method suggested by Fox and Kamprath (1971) using potassium dihydrogen phosphate and ammonium polyphosphate as sources of P. The data obtained from the phosphate adsorption experiments were fitted to the Freudlich and Langmuir equations at different solution P concentrations by using the equation b = q/c, where, b = buffering capacity, q = quantity factor, c = intensity factor.

The adsorption characteristics of these soils were studied by Shailaja and Sahrawat (1990). Phosphorus supply parameter (SP) was calculated using the expression described by Khasawneh and Copeland (1973).

$$SP = \sqrt{qc/\sqrt{k_1 k_2}}$$

where, q = P adsorbed per gram of soil, c = equilibrium concentration *i.e.* 0.2 µg mL^{-1}; k_1 and k_2 are constants determined by plotting 1/q *versus* 1/c (k_1 is reciprocal of intercept of $1/q \times 1/c$ plot and k_2

Table 2. *Phosphate buffering capacity of Vertisols*

Soil	Solution P concentration (μg P mL^{-1})							
	A	B	A	B	A	B	A	B
Kasireddipalle (BR-1)	374	237	291	160	191	108	30	43
Kasireddipalle (BW-6)	233	248	207	167	166	112	50	45
Barsi	423	342	343	228	238	152	44	59
Begamganj	488	321	372	217	237	146	34	59

Note: A = Langmuir isotherm, B = Freundlich isotherm; Source of P = KH_2PO_4

Table 3. *Phosphate buffering capacity of the Vertisols*

Soil	Solution P concentration (μg mL^{-1})							
	A	B	A	B	A	B	A	B
Kasireddipalle (BW-6)	244	233	213	157	167	106	45	42
Barsi	435	347	351	234	243	158	44	63
Begamganj	483	356	378	240	249	106	40	65

Note: A = Langmuir isotherm, B = Freundlich isotherm; Source of P = Ammonium polyphosphate

is slope of the plot of $1/q \times 1/c \times k_1$).

The buffering capacity of the soils calculated at different solution P concentrations using ammonium polyphosphate and potassium dihydrogen phosphate as 'P' source from Langmuir and Freundlich equations are given in tables 2 and 3.

The phosphate buffering capacity of the Vertisols calculated from Langmuir and Freundlich isotherm are given in table 2 and table 3. The phosphate buffering capacity of the soils decreases with the increase in solution P concentration when calculated from Langmuir and Freundlich isotherm. Sheppard and Racz (1984) however reported it in terms of desorption buffering capacity immediately after fertilizer P application and indicated that a higher buffering capacity (desorption) probably resulted from relatively large amounts of superficially adsorbed P at that time.

The supplying capacity of the Vertisols calculated from Langmuir isotherm is given in table 4. The Barsi and Begamganj soils have similar P supplying parameter. However, these values were higher when compared with BW-6. A similar supplying capacity in Barsi and Begamganj indicate that these soils have comparable capacity to supply P to the growing roots. Higher buffering capacity in Barsi and Begamganj soil indicate higher P supply capacity value.

Table 4. *Phosphorus supplying capacity of the Vertisols*

Soil	Supplying capacity
BW - 6	2.3
Barsi	2.5
Begamganj	2.5

Note: Langmuir isotherm was used

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