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Article

Distribution and Classification of Phosphorous Fractions and their Relationship with Soil Properties in Inceptisols of Prayagraj, Uttar Pradesh

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Abstract: Total Twenty-Four Samples were collected from the Four different depths of Prayagraj, Uttar Pradesh near the bank of Yamuna River and determined Phosphorous (P) fractions and their relationship with soil properties, The soils were Neutral, low salinity and medium to rich in organic matter in the surface to subsurface horizons. Most of the soils showed Low range in nitrogen and phosphorous and high in potassium. Among the P fractions, the most predominant were Ca-P and followed by Fe-P > S-P > Occl-P > Red-P > Al-P. The Overall results showed that the available-P, organic-P and total-P decreases with increase the depth, Where the Ca-P was significantly positively correlated with pore space (r = 0.396*), Organic Carbon (r = 0.555*), Available Nitrogen (r = 0.55*) and significantly negatively correlated with Clay (r = -0.324*), pH (r = -0.226*), EC (r = -0.232*). Total-P and Occ-P are main contributing factors for the availability of P. The regression equations showed that soil pH was the main soil property that influences the different fraction of P. The Nutrient Index of available P for Inceptisols was found under medium to low category, about 60% of Inceptisols are likely to respond of P-fertilizer.

Keywords: Phosphorous fractions; Inceptisols; Soil properties

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1. Introduction

Phosphorous (P) is the second most critical plant nutrient owning to its important role in the root proliferation and thereby biological nitrogen (N) fixation. Phosphorous in soil exists in both Organic and Inorganic forms on an average, Indian soils contain 44 to 3580 mg kg^{-1} of Total P and traces to 2160 mg kg^{-1} of organic P (Kaistha *et al.*,1999)

The inorganic phosphorous occurs in soil with combination of Iron (Fe), Aluminium (Al), Calcium (Ca), and other elements which are not soluble. Therefore, it is not available for both plant and microbial uptake. The insoluble fractions of P are neither available readily to growing plants nor to microorganisms and constitute 94 to 99% of the Total P. The fraction of P is mostly attached with Fe and Al to form variscite and stargate minerals in acid soils and with Ca to form apatite in neutral to alkaline soils Organic P compounds are mostly esters of orthophosphoric acid and have been identified primarily as inositol phosphates, phospholipids, and nucleic acids (Havlia *et al.*,2004)

2. Materials & Methods

Twenty-Four samples from four depths viz; 0-15,15-30,30-45, and 45-60 cm, collected from the different physiographic units of Prayagraj district of Meghalaya were used for study. The collected samples have been air dried, crushed with wooden mallet, and sieved to remove coarse (>2 mm) fragments. The soil pH was measured on 1:2 soil: water suspension using pH meter and salts content were determined by measuring the electrical conductivity EC of 1:2.5 soil: water extract (Jackson 1973). Organic Carbon was determined by wet oxidation method of (Walkley and Black 1934). Particle size distribution was determined by Bouyoucous hydrometer (Bouyoucous 1962). Graduated measuring cylinder was used to estimate the bulk density, particle density, pre space and solid space and water holding capacity (Muthuvel *et al.*,19). The specific gravity was determined by using Relative density bottle by (Black 1965). Available Nitrogen was determined as per method by (Subbiah and Asija 1956). Available Phosphorous was determined by (Olsen's 1954) method, Available Potassium was extracted with 1 N Nh_4OAc and then measured by Flame photometer by (Jackson1973). Ethylene diamine tetra acidic acid (EDTA) titration method (Jackson 1973) was used for exchangeable Ca and Mg. Free Iron Oxide (Fe_2O_3) percent was determined by using Atomic Absorption Spectroscopy. Total Sesquioxide (R_2O_3) and Free Aluminium oxide (Al_2O_3) content of soil was determined by (Piper, 1950) HCl extraction and subsequent precipitation with NH4 OH.

The Sequential extraction of inorganic soil Phosphorous fractions were determined as per (Chang and Jackson 1957) method, subsequently modified (Peterson and Corey1966). Soil samples were treated with 1.0 N NH_4Cl solution to extract loosely and easily soluble P (Saloid-P). The NH_4-soil was successively extracted with neutral 0.5 N NH_4F, 0.1 N NaOH and 0.5 N H_2SO_4 for Al-p, Fe-P and Ca-P, respectively. The extracted soil sample of ca-P was subjected to dithionate-citrate reduction for determination of reductant soluble P (Red-P) and subsequently extracted with 0.1 N NaOH for determining occluded P. Total P in soil was determined using nitric acid and percolic acid digestion method as suggested by (Hesse, 1971).Organic P was determine as the difference between total P and Inorganic P. Simple correlation analysis between soil properties and P fractions were prepared by standard statistical methods.

3. Results and Discussion

3.1. Characterization of Physio-Chemical properties of soil

Physico-chemical properties of soils that collected from the Inceptisols are presented in Table1. The Soil profiles contain high clay content compared with clay and silt, the mean of sand ranged 71.81%, silt 11 % and clay ranges 16.75% for all the samples and it said to be Sandy Loam Texture for all the soil profiles and the Clay and Sand content varies from topsoil to subsoil vice versa. Bulk density of the profile's ranges from 1.09 to 1.25 $Mgcm^3$, particle density varies from 4-6.6 $Mgcm^3$, percent pore space varies from 13-14% and solid space ranges from 86-87% respectively. Water holding capacity of the soil profiles ranges from 53-63% and specific gravity varies from 18-20 gcm^3. The soil samples were found neutral in nature, with medium exchangeable Ca content ranging from 23 to 36 $Cmol/kg^{-1}$ soil. They have neutral to Alkaline in reaction as reflected the pH values ranging from 7.2-7.4. With the average range of annual rainfall of Prayagraj district of about 1042 mm all soluble salts might have been leached out from the profile. This reflected in the very low saline soils in this region. EC values ranging from 0.29 to 1.5 dSm^{-1}. Organic carbon content of the soil's ranges from 0.4 to 0.9% with a mean of 0.68%. The Organic Carbon content of the topsoil was slightly higher than that of the subsoil. The medium to high content of OC in these soils can be probably explained as the most of the Inceptisols have rich in Organic matter. The Available Nitrogen content in soil was medium to low from topsoil to subsoil ranging from 193 to 84 kg ha^{-1}.

Available Phosphorous content in soil varies low and flowed a significant decrease along with the depth and ranged from 12-15 kg ha^{-1}. Available Potassium varies from 75-90 kg ha^{-1}.

3.2. Soil Phosphorous Fractions

The P fractions of soils are presented in table 2 and correlation coefficient among the P fractions and with the soil properties are presented in table 3 and 4, respectively.

Saloid-P (Sal-P)

Saloid P content in soil ranged from 2.0 to 3.0 ppm and comprised of 4.13%. The Sal-PSignificant positive correlation of Saloid P with Silt (r = 0.613*) and Pore space (r = 0.550*) was noticed. It was significantly negatively correlated with Sand (r = -0.41*), Clay (r = -0.321*), Bulk Density (r = -0.336*) Solid Space (r = -0.531*), Water Holding Capacity (r = -0.399*), Specific Gravity (r = -0.410*), pH (r = -0.475*), Exchangeable Magnesium (r = -0.372*) and Free Iron Oxide (r = -0.528*). The significant positively correlated with Ca-P (r = 0.564*), Inorganic P (r = 0.601*) due to strong weathering and negatively correlated with Fe-P (r = -0.4294*), Organic P (r = -0.63*). This might be due to the neutral pH. Saloid P is loosely or shortly correlated with Fe-P, Red-P and Organic P showing that profund effect with content of distribution of Saloid-P similar findings were found with (Vishwanath and Doddamani 1991)

Aluminium-P (Al-P)

The Al-P content ranges in these soil profiles from 1.61 to 1.83 ppm and the mean value of Al-P was 1.35 ppm. The Al-P comprised of 2.15% of the Total-P, very low content of the Total-P in the soils is the indication of strong weathering well drained humid tropics (Sarkar *et al.*,2014). Among the fractions Al-P significantly positively correlated with Occl-P (r = 0.43296*), Ca-P (r= 0.60712*), Mineral or Inorganic P (r = 0.67936*), along with Total P (r = 0.47862*) and found negative with Organic P (r = -0.1145*) while Al-P was positively correlated with Pore space (r = 0.332*), Aluminum Oxide (r = 0.897*) and Total Sesquioxide's (r = 0.893*) was noticed. It was significantly negatively correlated with Clay (r = -0.162*), Solid space (r = -0.307*), pH (r = -0.402*) and Exchangeable Magnesium (r = -0.213*).

Iron-P (Fe-P)

The Fe-P content of soil is one of the most important fractions of P influencing its availability in soils. Among all inorganic fractions. Fe-bound P showed the second-largest pool. This is expected by the soils as they are dominated by sesquioxide of Fe mineral (Arbind *et al.*,2020). The Fe-P in the soils ranged from 5.61 to 7.29 ppm with a mean value of 6.53 ppm. The Fe-P comprised of 10.44% of the Total-P. A Significant positive correlation of Fe-P with Sand (r = 0.647*), Water Holding Capacity (r = 0.869*) and Free Iron Oxide (r = 0.561*) was noticed. It was significantly negatively correlated with Silt (r = -0.650*) and Particle density (r = -0.423*). Fe-P was Positively correlated with Occl-P (r = 0.62468*), Red-P (r = 0.64746*), Total P (r = 0.54688*) similar findings were found with (

Prahalad *et al.*,2014) and Organic P (r = 0.2983*) due to mineralization and increase in the biological activity in soil similar findings were been found with (Sacheti & Saxsena 1973, Watham *et al.*, 2018, Arbind *et al.*, 2020, Bhavsar *et al.*, 2018).

Occluded-P (Occl-P)

The Occl-P in the soil P fractions ranged a medium level and it varies from 1.54 to 3.89 ppm, with a mean value is 2.55 ppm and it occupies 3.98% of the Total-P. Significant positive correlation of Occl-P with Sand (r = 0.354*),Water Holding Capacity (r = 0.543*), Available Phosphorous (r = 0.767*), Available Potassium (r = 0.427*), Free Iron Oxide (r = 0.497*), Aluminum Oxide (r = 0.516*), Total Sesquioxide's (r = 0.535*) was noticed and Negatively correlated with Silt (r = -0.356*), Occl-P was positively correlated with Total P (r = 0.80639*), Inorganic P(r = 0.55166*) and similar findings were found with (Bhavsar *et al.*, 2018, Arbind *et al.*,2020) Ca-P (r = 0.42321*), Organic P (r = 0.31083*).

Reductant-P (Red-P)

Reductant soluble P in the soil adsorbed by oxides or hydroxides of Fe and Al. The Red-P in the studied soils varies from 1.6 to 2.1 ppm, the mean value is 1.86 ppm and occupies 3.00% of the Total-P. Red-P was significantly positively correlated with Water Holding Capacity (r = 0.568*) and EC (r = 0.458*) was noticed. It was significantly negative correlated with silt (r = -0.213*), Particle density (r = -0.334*), pore space (r = -0.315*). Red-P was significantly positively correlated with Inorganic P (r = 0.27735*) similar findings were found with (Bhavsar *et al.*,2018, Prasad *et al.*, 1986, Arbind *et al.*,2020). This fraction was found as the second least fractioned among all the fractions. The low value of Red –P was observed in the soil having relatively higher pH and sand content. This might be due to iron and aluminium bound P content and rise in the content of calcium bound P.

Calcium-P (Ca-P)

The Amount of Ca-P in the soils ranged from 15 to 25 ppm and the mean value is 19.72, it occupies 31.57% of the total-P and resulted as the highest fractioned among all the fractions. This might be due to the average range of Ca^{2+} ions in the soil. The Ca-P significantly positively correlated with pore space (r = 0.396*), Organic Carbon (r = 0.555*), Available Nitrogen (r = 0.55*), Available potassium (r = 0.352*), Aluminum Oxide (r = 0.602*), Total Sesquioxide's (r = 596*) was noticed. It was significantly negatively correlated with Clay (r = -0.324*), Solid Space (r = -0.403*), pH (r = -0.226*), EC (r = -0.232*), Exchangeable Magnesium (r = -0.388*), Free Iron Oxide (r = -0.223*), significantly positively correlated with Mineral P (r = 0.96843*) and Ca-P (r = 0.30065*) and negatively correlated with Organic P (r = -0.5322*) similar findings were been found from (Bhavsar *et al.*,2018, Arbind *et al.*, 2020). the calcium bound P is normally the dominant inorganic soil P fraction. The close association of ca-P with Inorganic P was due to the dominance of Ca-P in Soils (Bhavsar *et al.*,2018).

Inorganic-P

Inorganic includes all the fractions of P i.e., S-P, Al-P, Fe-P, Occl-P, Red-P, Ca-P, the values ranged from 27 to 44 ppm respectively, and it has been seen that significant decrease in the levels of P from the upper layer to lower layer in all the profiles. Inorganic P was significantly positively correlated with pore space (r = 0.340*), EC (r = 0.491*), Available Nitrogen (r = 0.488*), Available Phosphorous (r = 0.336*), Available Potassium (r = 0.355*), Aluminum Oxide (r = 0.672*), Total sesquioxide's (r = 0.669*) was noticed. It was significantly negatively correlated with clay (r = -

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0.307*), Solid space (r = -0.351*) and pH (r = -0.329*). Inorganic or Mineral P was Significantly and positively correlated with saloid P (r = 0.601*), Al- P (r = 0.679*), Occl-P (r = 0.551*) and Ca-P (r = 0.968*) among the forms of P.

Organic-P

Total Organic P values ranged from 25 to 28 ppm respectively and it's been shown that significant decrease and irregular arrangement of Organic P in a few of the profiles. Organic P was Significantly Positively correlated with Clay (r = 0.420*), Bulk Density (r = 0.529*), Solid space (r = 0.414*), Available Phosphorous (r = 0.660*), Free Iron Oxide (r = 0.495*), was noticed. It was significantly negatively correlated with Silt (r = -0.452*), Pore space (r = -0.410*) and Available Nitrogen (r = -0.345*). The Organic P was Positively correlated with Occl-P (r = 0.310*) and Total-P (r = 0.627*) and negatively correlated with Saloid P (r = -0.630*), Ca-P (r = -0.532*) and Inorganic P (r = -0.463*).

Total-P

Average Total P values ranged from 57 to 72 ppm respectively, and the CD values for 0.5% is 8.77 and for 0.1% is 11.96 %, and it has been seen that significant decrease in the levels of P from the upper layer to lower layer in all the profiles. Total P was Significantly positively correlated with Bulk Density (r = 0.476*), Water Holding Capacity (r = 0.572*), Available Phosphorous (r = 0.979*), Available Potassium (r = 0.398*), Free Iron Oxide (r = 0.388*). Aluminum Oxide (r = 0.473*), Total Sesquioxide's (r = 0.488*) was noticed. It was significantly negatively correlated with Silt (r = -0.296*), Exchangeable Magnesium (r = -0.232*). Total P was positively correlated with Al-P (r = 0.478*), Fe-P (r = 0.546*), Occl-P (r = 0.806*), Ca-P (r = 0.300*) and Mineral P (r = 0.399*).

4. Conclusion

The soil analysis results were interpreted using the literature which help farmers and adds the deficient nutrients. According to the soil test results of Inceptisols of Prayagraj are Neutral to Alkaline in condition. All the soil samples were under permissible limits with the non-Saline condition of Electrical Conductivity and suitable for crops. 58.3% of the soil samples showed medium-high organic carbon content this is due to low and high temperatures and less decomposition of organic matter in the soil. More than 50% samples are resulted in low and medium ranges in Nitrogen, Phosphorous and high range in Potassium. More than 52% of the samples resulted a High range for Exchangeable Calcium, and 70% of the soil samples resulted low in Magnesium. Total Sesquioxide hydroxides of Iron and Aluminium ranged low and medium for Free Iron Oxide.

The Saloid P values ranged an average of 2.53 ppm (4.13%), Whereas the average Al-P of the samples ranged1.35 ppm (2.15%) lowest value among all fractions. Fe-P values ranged second-highest a 6.53 ppm (10.44%). Occl-P values ranged a 2.55 ppm (3.9%) with a medium-range compared to all the fractions. Red-P ranged a 1.86 ppm (3 %). Ca-P values ranged at 19.72 (31.27%) ppm ranging with the highest values among all the fractions. Whole values ranged as **Ca-P > Fe-P > S-P > Occl-P > Red-P > Al-P.** Total P ranges a mean of 34.58 ppm, whereas Inorganic P ranges a mean of 62.84 ppm and Organic P ranges with 28.24 ppm (44.70%).

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Table 1. Physio-chemical Properties of Inceptisols.

Locations	Depth	%Sand	%Silt	%Clay	BD	PD	Pore Space	Solid Space	WHC	SG	pH	EC	OC	Ca2+	Mg2+	N	P	K	Fe2O3	Al2O3	R2O3
Description	cm	%			Mg m^{-3}		%		%	gcm^{-3}	w/v	dSm^{-1}	%	C mol/kg^{-1}		Kg ha^{-1}			%		
Profile 1(Mehewa)	0-15	71	16	13	1	2	16	84	56	19	6.8	0.29	0.9	26.2	5	189	13	78	2.4	0.08	2.48
	15-30	69	14	17	1.1	2.5	14	86	54	20	6.9	0.29	0.9	25	13.8	189	12	78	1.12	0.08	1.21
	30-45	65	17	18	1.1	2.6	17	83	50	11	7.1	0.24	0.8	25	4.6	168	12	101	1.12	0.09	1.21
	45-60	69	17	14	1.1	2.8	13	87	47	13	7.2	0.22	0.4	29.6	6.6	84	13	112	1.8	0.1	1.9
Profile 2(Arial)	0-15	72	15	13	1.1	2.4	15	85	61	18	7.6	0.29	1.08	26.2	6.8	226	14	79	2.18	0.09	2.26
	15-30	72	16	12	1	2.5	16	84	51	11	7.4	0.29	1.03	26	6.8	216	13	82	2.06	0.08	2.14
	30-45	64	18	13	1	2.6	15	85	50	11	7.3	0.22	0.82	17.6	6.6	172	14	90	1.23	0.08	1.31
	45-60	72	16	13	1.1	2.8	15	85	50	20	7.3	0.12	0.6	15	4.2	126	13	101	1.11	0.09	1.2
Profile 3 (Lawayan)	0-15	71	14	14	1.1	2.6	15	85	71	23	7.5	0.2	1.59	29.6	9.2	333	14	101	2.03	0.08	2.11
	15-30	71	15	14	1	2	15	85	65	15	7.6	0.26	1.35	30.2	11.4	283	13	95	1.56	0.08	1.64
	30-45	65	17	18	1.3	2.3	14	86	47	14	7.8	0.26	0.88	16.4	11	184	13	82	1.22	0.08	1.3
	45-60	69	14	16	1	2.4	16	84	47	24	7.9	0.29	0.45	29.4	14.6	94	11	60	1.11	0.09	1.2
Profile 4(Dewrakh)	0-15	73	7	21	1.3	2.3	13	87	68	20	6.8	0.17	0.61	28	9.8	128	21	108	2.1	0.12	2.22
	15-30	79	4	17	1.2	2.2	12	88	64	28	7.5	0.27	0.52	40	6	109	14	98	1.88	0.12	2
	30-45	71	9	26	1.2	2.2	11	89	63	28	7.2	0.2	0.52	33	16.8	128	14	74	1.27	0.12	1.39
	45-60	74	6	20	1.2	2.2	10	90	63	21	7.1	0.6	0.15	22	21.6	31	14	63	1.06	0.11	1.17
Profile 5 (Naini KVK)	0-15	73	8	19	1.3	2.3	13	87	66	20	7.2	0.69	0.45	27	11	94	17	82	2.35	0.12	2.47
	15-30	80	5	15	1.1	2.1	12	88	61	20	7.3	0.67	0.37	30	24.4	77	13	74	1.25	0.11	1.36
	30-45	72	9	19	1.1	2.1	11	89	61	25	7.3	0.66	0.3	24	14.6	63	13	62	1.55	0.11	1.66
	45-60	72	8	21	1.1	2.2	14	86	57	20	7.4	0.65	0.3	31	51.4	63	11	51	1.51	0.1	1.61
Profile 6(Chaka)	0-15	73	6	13	1.1	2.2	13	86	61	17	7.7	0.68	0.9	17	22.6	189	14	92	1.15	0.13	1.28
	15-30	80	6	14	1.2	2.3	12	88	60	18	7.9	0.24	0.52	31	17	109	13	81	1.14	0.12	1.26
	30-45	74	7	19	1.2	2.2	12	88	56	19	7.9	0.21	0.52	22.4	22.2	109	13	77	1.46	0.12	1.58
	45-60	73	5	22	1.3	2.3	10	90	54	22	7.9	0.17	0.52	28.2	7.2	109	13	64	1	0.11	1.11
Mean		71.81	11.08	16.75	1.11	2.34	13.48	86.46	57.63	19.04	7.4	0.34	0.69	26.24	13.55	144.71	13.54	82.71	1.53	0.1	1.63
Sem		1.39	2.07	1.41	0.036	0.092	0.853	0.837	2.44	2.079	0.14	0.57	0.12	2.25	4.3	44.3	0.694	6.62	0.007	0.143	0.142
CD (P=0.5%)		4.103	NS	NS	NS	NS	NS	NS	7.211	NS	NS	NS	0.369	NS	NS	26.19	2.04	NS	NS	NS	0.419

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Table 2: Distribution of phosphorous fractions in Inceptisols

Locations	Depth	Saloid P	Al-P	Fe-P	Occl-P	Red-P	Ca-P	Mineral P	Total-P	Organic-P
				(ppm)						
Profile 1(Mehewa)	0-15	6.35	2.24	5.77	3.028	2.0232	35.09	54.5012	62.02	7.5188
	15-30	7.06	1.66	5.71	1.258	1.6123	22.105	39.4053	59.4	19.9947
	30-45	6.04	1	4.94	2.654	1.4025	21.436	37.4725	57.92	20.4475
	45-60	5.65	0.99	5.33	2.125	1.8157	21.305	37.2157	55.06	17.8443
Profile 2(Arial)	0-15	5.99	1.96	7.29	3.58	2.1347	27.773	48.7277	65.934	17.2063
	15-30	4.23	1.9	5.8249	2.369	1.569	19.531	35.4239	62.143	26.7191
	30-45	2.12	1.09	5.3256	2.147	1.2588	13.817	25.7584	62.976	37.2176
	45-60	1	1	4.8239	1.654	1.1236	10.651	20.2525	60.583	40.3305
Profile 3 (Lawayan)	0-15	1.06	1.8	7.4569	2.321	2.4123	24.653	39.7032	63.759	24.0558
	15-30	1.34	1.34	7.2582	2.147	2.1478	22.736	36.969	61.053	24.084
	30-45	2.23	1.06	5.8321	1.569	1.8523	20.852	33.3954	58.369	24.9736
	45-60	2.44	0.98	5.2236	1.258	1.6587	18.963	30.5233	52.369	21.8457
Profile 4(Dewrakh)	0-15	1.8	1.89	8.0206	5.698	1.4472	25.087	43.9428	97.188	53.2452
	15-30	1.6	1.69	7.4424	3.247	1.3816	22.654	38.015	64.783	26.768
	30-45	1	1.09	7.1467	2.147	2.8056	17.085	31.2743	63.519	32.2447
	45-60	0.86	0.86	7.5366	1.528	2.3525	16.212	29.3491	62.883	33.5339
Profile 5 (Naini)	0-15	2.15	2.15	7.6103	4.217	2.5381	19.161	37.8264	78.735	40.9086
	15-30	1.02	1.02	8.2386	3.258	2.1466	13.711	29.3942	59.811	30.4168
	30-45	1.35	1.35	7.4569	2.369	2.3692	13.193	28.0881	58.802	30.7139
	45-60	1.39	1.39	5.3147	1.456	1.4569	12.65	23.6576	52.149	28.4914
Profile 6(Chaka)	0-15	0.96	0.96	7.6258	4.525	2.3698	23.403	39.8436	66.887	27.0434
	15-30	0.95	0.95	7.3698	3.247	2.1478	18.738	33.4026	61.33	27.9274
	30-45	1.31	1.31	6.4582	2.369	1.4569	17.258	30.1621	60.2	30.0379
	45-60	0.87	0.87	5.852	1.258	1.3692	15.413	25.6322	59.87	34.2378
Mean		2.53	1.35	6.53	2.55	1.86	19.72	34.58	62.82	28.24
Sem		0.89	0.131	0.38	0.316	0.18	1.67	2.1	2.97	4.02
CD (P=0.5%)		NS	0.38	1.13	0.91	NS	4.95	6.21	8.77	NS

Table 3: Correlation co-efficient (r) between Physio-chemical properties and fractions of phosphorous in Inceptisols

	Saloid P	Al-P	Fe-P	Occl-P	Red-P	Ca-P	Mineral P	Total-P	Organic-P
%Sand	-0.4178	0.0768	0.64724*	0.3545	0.22149	-0.0786	-0.0068	0.16746	0.16764
%Silt	0.6131*	0.11271	-0.6501	-0.3561	-0.2135	0.26161	0.19535	-0.2963	-0.4524
%Clay	-0.3212	-0.1623	0.13832	-0.1109	0.12995	-0.3244	-0.3073	0.16517	0.4207*
BD	-0.3366	-0.0728	0.38485	0.27282	0.10988	-0.1259	-0.0811	0.47636	0.5294*
PD	0.3157	-0.1523	-0.5478*	-0.2191	-0.4143	-0.1733	-0.1773	-0.1109	0.04337
PS	0.55093*	0.33224	-0.5334*	-0.0389	-0.3152	0.39699	0.34043	-0.125	-0.4101
SS	-0.5317	-0.3073	0.4996*	-0.0059	0.28821	-0.4036	-0.3512	0.11996	0.4143*
WHC	-0.3998	0.40305*	0.8695*	0.5430*	0.5681*	0.21543	0.29817	0.5727*	0.30031
SG	-0.4101	0.0813	0.4048*	-0.0182	0.2992	-0.1024	-0.1031	0.08349	0.16832
pH	-0.4375	-0.4023	-0.0003	-0.2277	-0.0362	-0.227	-0.3294	-0.3784	-0.086
EC	-0.2189	0.00969	0.4056*	0.19288	0.4580*	-0.2324	-0.1073	-0.0209	0.07101
OC	0.2651	0.38626	-0.0012	0.07253	0.07436	0.555*	0.49105	0.07063	-0.349
Ca^{2+}	-0.0148	0.24573	0.30664	0.10565	0.15146	0.18396	0.20378	0.02134	-0.1525
Mg^{2+}	-0.3729	-0.2137	0.12732	-0.1208	0.1372	-0.3889	-0.371	-0.2321	0.09078
N	0.25889	0.38099	0.00364	0.06885	0.09606	0.5528*	0.4885*	0.07178	-0.3457
P	-0.181	0.40737*	0.5579*	0.76753	0.13646	0.23973	0.33608	0.979	0.6608*
K	0.1896	0.13068	0.0221	0.428*	-0.1756	0.35246	0.35515	0.39882	0.08379
Fe_2O_3	-0.5287	-0.1845	0.5610*	0.4976*	0.2491	-0.2238	-0.141	0.38831	0.4951*
Al_2O_3	0.31721	0.89702*	0.26937	0.5162*	0.18379	0.6024*	0.6727*	0.4732*	-0.1141
R_2O3	0.29926	0.89347*	0.29051	0.5359*	0.19339	0.5964*	0.6699*	0.488*	-0.0966

***Significant at 0.05%**

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Table 4: Correlation co-efficient (r) Among the Phosphorous Fractions of Inceptisols

	Saloid P	Al-P	Fe-P	Occl-P	Red-P	Ca-P	Mineral P	Total-P	Organic-P
Saloid P	1								
Al-P	0.3985	1							
Fe-P	-0.4294	0.2189	1						
Occl-P	-0.0311	0.43296*	0.62468*	1					
Red-P	-0.1724	0.10238	0.64746*	0.22347	1				
Ca-P	0.56411*	0.60712*	0.15283	0.42321*	0.19652	1			
Mineral P	0.60194*	0.67936*	0.27115	0.55166*	0.27735	0.96843*	1		
Total-P	-0.1226	0.47862*	0.54688*	0.80639*	0.10295	0.30065	0.39964	1	
Organic-P	-0.63	-0.1145	0.2983	0.31083	-0.1361	-0.5322	-0.4633*	0.62716**	1

***Significant at 0.05%**

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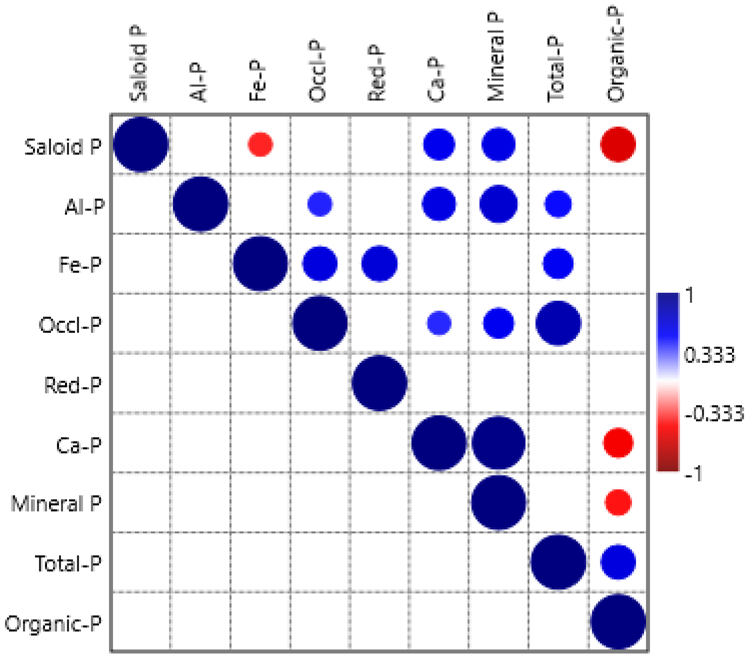

Fig 1. Graphical representation of Correlation co-efficient (r) Among the Phosphorous Fractions of Inceptisols