ISSN: 2278-6252
Impact Factor: 6.655

DIVERSE PHOSPHORUS FRACTIONS IN VARIOUS SOIL TYPES IN NORTHERN CENTRAL INDIA

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ABSTRACT

JNKVV Farm, Jabalpur we investigated the phosphorus fractions in typical agricultural soils belonging to three soil orders: Vertisol (common), Inceptisol (common), and Alfisol (rare) (common). By looking at the results, it was discovered that the highest soil pH was discovered inVertisols, with a range of 7.5 to 7.6, followed by Alfisols, with a range of 6.3 to 7.1, and the lowest pH was discovered in Inceptisols, with a range of 6.2 to 6.7 soil types, and that the greatest soil pH was discovered in Vertisols. EC was found to be present in all orders 1 dS m-1 in the normal range when measured at 25°C. Among the agrochemicals with the highest CEC values are Vertisols, which are followed by Inceptisols and Alfisols, which have the lowest values. The available nitrogen content in diverse soils varied from 239.1 to 302.7 kg ha-1, depending on the soil type studied. Depending on the soil type, the available phosphorus content in three soil groups varied from 11.24 kg ha-1 to 30.7 kg ha-1.

Keywords: Vertisols, Inceptisols, Nitrogen, Phosphorus, And Potassium

INTRODUCTION

Nitrogen (N) is an essential ingredient in the growth and development of crops, and phosphorus (P) is a critical component in the development of crops as well (Withers et al., 2008). Most inorganic phosphorus and one-third of the organic phosphorus are inaccessible in soil, especially in soils with changing charges. During the growing phase of the crop, “the rate of P consumption is quite low. Because at least 70 to 90 percent of the phosphorus (P) that enters the soil is fixed, making it difficult for plants to absorb and use, soil fertilizers such as iron, aluminum, and calcium are a key contributor to poor phyto-availability (McBeath et al., 2005).”According to the literature, organic inputs have been shown to enhance the availability of phosphorus in P-fixing soils, whilst humic compounds have been shown to boost the bioavailability of phosphorus fertilisers in acidic soils (Hua et al., 2008).

Humic acids and citrate, which are breakdown products of manure, were revealed to have a stronger affinity for aluminium oxides than they do for phosphorus oxides, according to the researchers. It is commonly used in plant biology to refer to the amount of soil phosphorus that can be extracted from solution or taken up by plant roots and then utilised by the plant during its life cycle in order for it to grow and develop. Because of the constant uptake of phosphorus by plants, the concentration of readily available phosphorus is constantly low. "Acid soils have low efficiency for phosphorus fertilizers due to P fixation by soluble Fe and Al as well as adsorption by Fe oxides, all of which diminish the effectiveness of the fertilizer." In agriculture, phosphorus (P) is a critical component because of its intricate transformation in the soil, which makes it difficult to make it available to plants, especially in the tropics, because of its limited availability. When it comes to crop production in Indian vertisols, a deficiency in this element is one of the most serious nutritional constraints (Bansal and Sekhon, 1994).

MATERIALS AND METHODS

The research area and study locations are described in detail. Located at "23°12'57" latitude and 79°56'49" longitude in the Indian city of Jabalpur, at a height of 383.3 meters above mean sea level, it is a popular tourist destination. soils were used in the Breeder Seed Production of Field Crops (BSP-FC) experiment." This farm's soil order was Alfisol, and the soil types were Typic and VerticHaplustalf, Fine loamy, and mixed, hyperthermic soils, which were referred to as sehra soils in the local language. Krishi Nagar Research Farm's soil types were "Typic and VerticHaplustalf, Fine loamy and mixed, and hyperthermic soils. The soils used were characterized as TypicUstochrept, Fine Loamy, and Mixed (Tripathi, 1998)."

Estimates of phosphorus concentrations based on preliminary data

For fractionating phosphorus from soil samples, we used the method established by Chang and Jackson (1957) and updated in part by Peterson and Corey (1966) that was originally devised by Chang and Jackson. To get the final composition of the sample, the sequence of Saloid-P, Al-P, Fe-P, Occluded-P, and Ca-P from each sample was run through a 60 mesh filter to remove any impurities.

For the determination, prepare five milliliters of an extract in a volumetric flask and dilute it to the desired concentration in a volumetric flask filled with 25 milliliters of water. Shake the contents of the flasks well, then add four milliliters of the reagent mixture to each flask

(ascorbic acid). The color intensity was measured within 10 minutes after calibrating the spectrophotometer to a reading of 100 transmittances using a blank created after the instrument was calibrated to that reading. Every year, the amount of phosphorus present in the soil was measured in kilograms per hectare.

Flow chart of phosphorus fractions

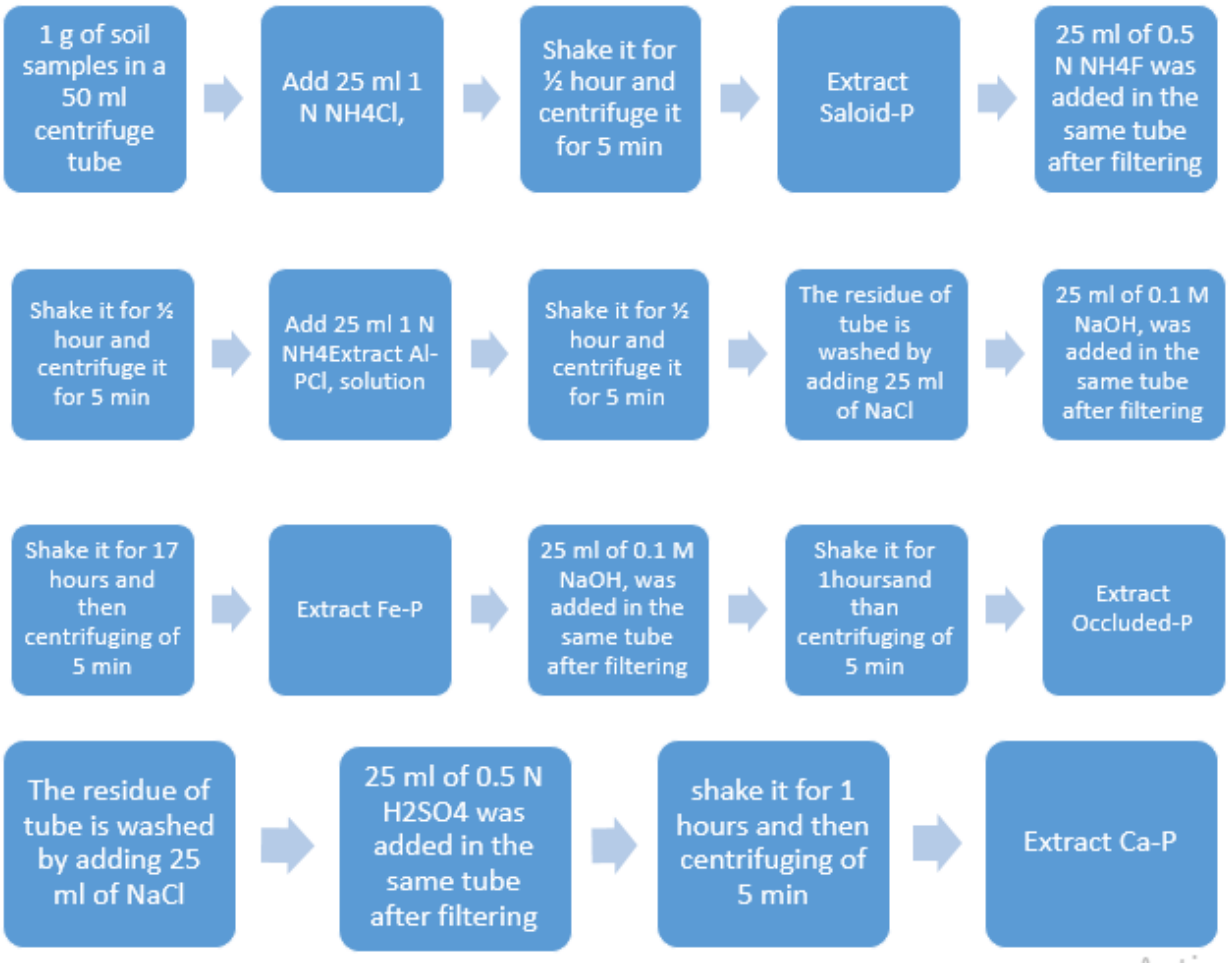

Table.1 Details of soil used

Farm	*Soil orders*	*Site*	*Latitude*	*Longitude*	*Cropping system*	*Sample No*
BSP-Field Crops	*Vertisols*	*(V1)*	*N-23°12'02.4"*	*E-79°56'40.7"*	*Soybean-Wheat*	*3*
		(V2)	*N-23°12'50.1"*	*E-79°56'47.0"*	*Soybean-Wheat*	
		(V3)	*N-*	*E-*	*Soybean-*	

			23°13'44.6"	79°56'36.7"	Wheat	
Krishi Nagar Research Farm	Alfisols	(A1)	N-23°12'17.6"	E-79°57'17.6"	Rice-Wheat	3
		(A2)	N-23°12'18.2"	E-79°57'32.1"	Rice-Wheat	
		(A3)	N-23°12'27.8"	E-79°57'24.3"	Rice-Wheat	
BSPGroundnut	Inceptisols	(I1)	N-23°12'53.1"	E-79°57'59.2"	Rice-Wheat	3
		(I2)	N-23°12'56.7"	E-79°57'47.5"	Rice-Wheat	
		(I3)	N-23°13'04.8"	E-79°57'48.1"	Rice-Wheat	

Table.2 Soil properties of different soils

A. Site	B. pH	C. OC (g kg-1)	D. EC (dS m-1)	E. CEC [cmol(p+) kg-1]	F. CaCO3 (g kg-1)	G. Clay (%)	H. Available major nutrient (kg ha-1) N	I
K. (V1)	L. 7.5	M. 5.9	N. 0.3	O. 58.2	P. 40	Q. 50	R. 267.7	S
U. (V2)	V. 7.59	W. 6.6	X. 0.2	Y. 62.7	Z. 60	AA. 55	BB. 302.7	C
EE. (V3)	FF. 7.6	GG. 5.8	HH. 0.2	II. 55.3	JJ. 45	KK. 52	LL. 250.8	M
OO. (A1)	PP. 6.3	QQ. 5.3	RR. 0.1	SS. 44.9	TT. 60	UU. 25	VV. 279.9	W
YY. (A2)	ZZ. 6.9	AAA. 4.8	BBB. 0.1	CCC. 48.2	DDD. 70	EEE. 20	FFF. 245.0	C
III. (A3)	JJJ. 7.1	KKK. 5.2	LLL. 0.15	MMM. 47.5	NNN. 40	OOO. 22	PPP. 276.9	C

SSS. (I1)	TTT. 6.7	UUU. 4.6	VVV. 0.08	WWW. 45.7	XXX. 65	YYY. 25	ZZZ. 239.1	A
CCCC. (I2)	DDDD. 6.2	EEEE. 5.5	FFFF. 0.09	GGGG. 48.9	HHHH. 70	IIII. 30	JJJJ. 251.0	K
MMMM.(I3)	NNNN. 6.3	OOOO. 5.6	PPPP. 0.07	QQQQ. 46.7	RRRR. 45	SSSS. 32	TTTT. 272.2	U

Table.3 Phosphorus fraction (kg ha-1) in different soils

RESULTS AND DISCUSSION

The present situation of soil physicochemical characteristics is described in detail. At the JNKVV farm, the soil pH of several soil orders was measured. The soil orders "V1, V2, and V3 (Vertisols), A1, A2, and A3 (Alfisols), and I1, I2, and I3 (Inceptisols) were determined to be 7.5, 7.5, and 7.6, 6.3, 6.9, and 7.1, and 6.7, 6.2, and 6.3 in Jabalpur, respectively. The soil orders V1, V2, and V3 (Vertisols), A1, A2, and A3 (At the JNKVV farm, the soil pH of several soil orders was measured. Ja Depending on the experiment, the EC ranged from 0.07 to 0.35 dS m-1 (decibels per meter squared)." At 25°C, it was safe in the three soil order limits of 1 dSm-1 and less in the three soil order limits. Depending on the soil order studied, the organic carbon content of soil ranged from 4.6 g kg-1 to 6.60 g kg-1. On the other hand, Vertisol had the highest amounts of OC, with values as high as 6.6, 5.9, and 5.87 g kg-1 in the three variants of V2, V1, and V3, respectively. "Alfisols A1 through A2 had 5.3, 5.2, and 4.80 grams of organic carbon per kilogram of dry weight, respectively, according to the results. However, the organic carbon content of Inceptisols was found to be low in I3, I2, and 1 with values of 5.6, 5.5, and 4.60g kg-1, respectively, in I3, I2, and 1 in Inceptisols. Raghuwanshi and colleagues (1992) investigated the CaCO3 concentrations of soil orders V1, V2, and V3 (Vertisoils); A1, A2, and A3 (Alfisoils); and I1, I2, and I3 (Inceptisols)." They found that the CaCO3 concentrations of soil orders V1, V2, and V3 (Vertisoils); A1, A2, and A3 (Alfisoils); and I1, I2 Colored soils ranged in pH value from 5.8 to 6.8, whereas black soils in the Indian city of Jabalpur ranged in pH value from neutral to alkaline (pH 7.2). Organic carbon was found to be low in Inceptisols and high in Vertisols, with Inceptisols having the lowest levels of organic carbon of the two types (Fig. 2). The high concentration of organic matter in the soil may be linked to the incorporation of organic matter into the top layer of the soil via the roots of plants as well as other plant wastes and manures, which have occurred in recent years. Moreover, crop species and cropping systems may play a significant role in maintaining SOC stock because both the quantity and quality of residues

that are returned to the soils can vary greatly, affecting their turnover or residence time in the soil and, as a result, the quality of the soil. (Tripathi et al.) have also reported pH values in the same range as previously reported (1994). The researchers Tomar (1968) and Singh et al. (2001) discovered comparable results for a range of black soils in their respective studies (2014). Following a thorough analysis, it has been found that the soils do not have a calcareous character. Singh and colleagues came to conclusions that were comparable to ours. It was discovered that the maximum "CEC content was "58.3, 62.7, and 55.2 cmol(p+) kg-1 in soil orders V1, V2, and V3 (Vertisols), respectively, followed by 44.9, 48.2, and 47.5 cmol(p+) kg-1 in soil orders A1, B1, B2, and B3 (Alfisols), as well as I1, I2, and I3 (Inceptisols) soil orders, respectively." It was discovered that the lowest CEC concentration was 44.9 Alfisols and Inceptisols had the very minimum amount of CEC contained in them. Vertisols, on the other hand, were determined to have the highest concentration." The presence of increased clay content in soils of Vertisols is probably responsible for the higher CEC seen in these soils. CEC of clay soils derived from basaltic rocks was shown to rise with increasing clay content, according to Pathak (1983). Matike et al. (2011) and Singh (2014) (Tables 1–3), as well as other studies, found results that were similar to Matike et al. (2011) and Singh (2014).

CONCLUSION

Phosphorus fractions in different soil orders Vertisols

After that, the P fractions in the vertisols V1 and V2 were analyzed in the following order: With values of "47.7>18.7> 12.0>11.1>10.3 kg ha-1 and 38.3>19.5> 16.3>16.0>8.7 kg ha-1, Ca-P is followed by Al-P, then Occluded-P, then Saloid-P, and the percent contributions are 35.9> 14.1>9.0> 8.3>7.8 and 3.35> The following sequence, on the other hand, was seen in V3 soil: Ca-P>Al-P>Occluded-P>FeP>Saloid-P. 31.9>24.4>17.6>13.7>12.4 kg ha-1 were obtained, and the corresponding percent contributions were 24.68>18.89> 13.59 > 10.58 > 9.61 percent of total-P." A recent study by Ojo et al. (2015) found that differences across soil types in terms of the P fractions are highly impacted by the kind of soil under investigation. As a result of the interactions between soil parent material, weathering, and other pedogenic processes, a variety of soil orders with varying total P concentrations are produced.

Alfisols

The results of the study revealed that the following P fractions were abundant in A1 and A2 of the Alfisols soil order: "calcium-phosphorus (CaP), iron phosphorus (FeP), aluminum phosphorus (AlP), occluded phosphorus (Occluded-P), and saloid phosphorus (Saloid-P), with values of 34.1>26.5>18.6>13.3>11.5 and 32.8>28.0>2 The Ca-bound P fraction was found to be the most prevalent of the various P fractions in the Vertisols and Alfisols studied." The quantity of P that was occluded within the Fe-oxides and hydrous oxides fractions was largest in the Vertisol, to be specific (Datta and Chandra, 2008).

Inceptisols

Following calcium-phosphorus (CaP), aluminum phosphorus (AlP), occluded phosphorus (FeP), and saloid phosphorus (Saloid-P), with values of "28.3>19.7>16.75>16.75>7.11 kg ha-1; 33.59>17.69>16.85 >11.27>9.1 kg ha-1, and 30.1>19.5>12.0> 10.5 kg ha-1, respectively, and percent contributions It is possible that the low quantity of Fe-P in these soils, in contrast to Al-P and Ca-P, is due to the greater activity of Al3+ and Ca2+ ions in these soils than Fe3+ ions in these soils. The results of Patgundi et al., as well as the findings of this investigation, are in agreement with one another." Increased availability of phosphorus in P-fixing soils is enhanced by organic amendments by modulating the P fractions present in the soil (Reddy et al., 1999).

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ISSN: 2278-6252
Impact Factor: 6.655

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