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Relationship Between Soil pH and Available Phosphorus: A Quantitative Analysis Across pH Gradients

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Abstract: Soil pH is among the most influential factors influencing the availability of phosphorus (P) in soils, and has an effect on the chemical form and the mobility of P. The present research evaluated the relationship between the soil pH and the available phosphorus within a wide pH (3.0-10.0) span. In order to give uniformity to the analysis, repeated values were reduced to several pH intervals.

The findings showed that there was a high change in the availability of phosphorus according to soil pH. The relationship between the pH and the available phosphorus in strongly acidic soils (pH 3-5) was insignificantly negative (r = -0.210), indicating low availability due to fixation by iron and aluminum. In the pH range of 5 to 6, a positive association though slightly positive (r = 0.389), was observed with more phosphorus availability with a lower acidity of the soil. Nevertheless, this relationship was very weak in nearly neutral soils (pH 6-7) (r = 0.024) which suggests comparatively constant phosphorus concentrations. At slightly alkaline conditions (pH between 7 and 8) the correlation was weakly negative (r = -0.053), but at the pH between 8 and 9, a very weak relationship was positive (r = 0.046). A further increase in pH made the relationship negative again (r = -0.209), presumably because phosphorus was precipitated with the calcium compounds.

Overall, the results show that even though soil pH influences the availability of phosphorus, this correlation is weak to moderate and is affected by pH ranges. This implies that soil properties other than pH are of significance in the control of phosphorus. The study further says that the availability of phosphorus and efficiency of nutrient use can be improved by maintaining the soil pH nearly at the neutral level, which is significant in the production of crops.

Keywords: **Soil pH; Phosphorus availability; Nutrient dynamics; Phosphorus fixation; Sustainable agriculture**

INTRODUCTION

Phosphorus (P) is a nutrient that is required in plant growth. But it is usually limited in soils by chemical reactions that convert it into strongly sorbed or weakly soluble forms (Khaled and Sayed, 2023). Soil pH is among the most important soil parameters since it regulates the larger percentage of phosphate species in solution and the extent of P fixation with aluminum, iron, and calcium (Cerozi & Fitzsimmons, 2017). Phosphorus is required in the growth of plants. Nevertheless, its biomagnification in the soils is often limited due to chemical reactions which convert it to weakly soluble or strongly sorbed compounds (Khaled & Sayed, 2023). One of the most significant characteristics of soil, which influences the P behavior, is the soil pH because it determines the dominant phosphate species in the solution and the degree of P fixation with aluminum, iron, and calcium (Cerozi & Fitzsimmons, 2017). Soluble phosphate (mostly) interacts easily with Al and Fe oxides in very acidic soils to generate insoluble Al–P and Fe–P compounds, which decrease P mobility and plant availability (MOFGA, 2021; NRCS, 2022). Conversely, in alkaline soils, phosphate and calcium tend to precipitate as calcium phosphate minerals that are sparingly soluble, especially hydroxyapatite-type phases, which also reduce available P. (Penn & Camberato, 2019; NRCS, 2022).

According to empirical data, available P is often maximum in the near-neutral pH range (about 6.0–7.0), where precipitation with Ca and fixation by Al/Fe are both comparatively low (Khaled & Sayed, 2023). However, rather than offering a fine-scale quantitative study throughout the whole pH spectrum, the majority of current research characterize this pH–P relationship in broad, frequently qualitative terms or concentrate on specific pH intervals (Penn & Camberato, 2019). Specifically, not much is known regarding the direction and magnitude of the relationship between pH and available P within narrower pH bands (e.g., 3–5, 5–6, and 6–7), which would be valuable for improving pH management recommendations in different types of soil. Also, pH is just one component of a more complex system, with clay content, organic matter, Fe and Al oxides, and calcium carbonate content all having a significant impact on P fixation and release, according to the generally weak to moderate correlations found in numerous datasets (NRCS, 2022; MOFGA, 2021).

By offering a quantitative study of the relationship between soil pH and available phosphorus throughout a broad pH gradient (3.0–10.0), the present study aims bridging these knowledge gaps. The paper compares the strength and the magnitude of the relationship between pH and available P across the pH scale by dividing data into different pH intervals and performing repeated measurements. The objectives are to know the pH level where P availability is most susceptible to change in pH, to explain the circumstances where pH management enhances phosphorus use efficiency, and to demonstrate the need of combined soil fertility methods considering both pH and other inherent soils properties. It is anticipated that the findings will facilitate more accurate and long-term P management in a variety of agricultural environments.

METHODOLOGY

Soil Sample Collection and Preparation

Two hundred and fifty-six soil samples having a wide range of pH (3 to 10) were collected from Uttarakhand, Rajasthan and Maharashtra states. The soils were grouped under six categories based on pH value. Samples were taken from the surface layer (0–15 cm) and were air-dried, gently crushed, and sieved through a 2 mm sieve before analysis. Soil pH was determined by using a calibrated digital pH meter, using a 1:2.5 soil–water suspension. The soils were grouped under six categories (pH between 3 and 5, pH between 5 and 6, pH between 6 and 7, pH between 7 and 8, pH between 8 and 9, and pH between 9 and 10). Three replicates of each soil were analysed for available phosphorus.

Estimation of available phosphorus

Following extraction, the amount of available phosphorus in the soil samples was calculated based on the pH of the soil. The Olsen extraction method (1954) was used for neutral to alkaline soils, while the Bray and Kurtz approach (1945) was used for acidic soils to extract phosphorus in acidic fluoride extractant. A colorimetric approach was used to measure the amount of phosphorus in the filtrate. The creation of a blue complex called ammonium phosphomolybdate provided the basis for the analysis, and absorbance was measured at a wavelength of 660 nm. A calibration curve made from standard solutions using KH_2PO_4 was used to determine the amount of available phosphorus.

Statistical Analysis

Pearson's correlation coefficient (r) for each pH range was used to evaluate the relationship between soil pH and available phosphorus; linear regression analysis was used to characterize the relationship between variables; the coefficient of determination (R^2) was calculated to evaluate the strength of the model; statistical significance was considered into accounts at $p \leq 0.05$.

RESULTS

The relationship between soil pH and available phosphorus (P) was examined across a wide pH range (3–10) (Fig.1-2). The findings revealed that there is a significant range of the available P (2.6 mg/kg to 276.3 mg/kg) under various pH ranges (Table 2).

Available phosphorus varied widely in strongly acidic soils (pH 3-5). There was a weak negative correlation (r = -0.210) between phosphorus availability and increasing pH level (Fig 1.A). The low coefficient of determination ($R^2 = 0.044$) and regression analysis ($y = -21.177x + 185.56$) show that the soil pH did not play an important role in the availability of phosphorus in this range.

A medium positive correlation (r = 0.389) was found between the available phosphorus and the soil pH in the 5 to 6 pH range. The regression model ($y = 113.43x -546.35$) indicates the trend of increase in phosphorus availability as the pH increases. Nonetheless, the R^2 value (0.1512) was relatively low which suggests that the variability could not be entirely accounted by pH alone (Fig 1.B).

The correlation between soil pH and phosphorus availability had a very weak positive correlation (r = 0.024), indicating that near-neutral soils (pH 6-7) did not show any significant association between soil pH (Fig 1.C) and phosphorus availability. The regression equation ($y = 5.2148x + 35.279$) and the very low R^2 value (0.0006) further affirm the fact that pH had little effect on phosphorus availability in such circumstances.

In slightly alkaline soils (7-8 pH, Fig. 2.A), weak negative correlation was found (r = -0.053). The regression equation ($y = -12.849x + 161.44$) shows that the phosphorus was slightly decreasing with an increase in pH but the value of R^2 is very low (0.0028) implying that this was not a significant correlation.

The positive correlation between phosphorus availability and moderately alkaline soils (pH 8-9, Fig. 2.B) was very weak (r = 0.046). The regression equation ($y = 6.7379x -33.15$) shows that available phosphorus was marginally increasing with the increase in pH but the value of R^2 (0.0021) is very small hence the trend was not strongly defined.

A weak negative relationship (r = -0.209) was again noted in highly alkaline soils (pH 9-10, Fig. 2.C). The regression equation ($y = -15.569x + 169.25$) shows decrease in phosphorus availability with an increase in pH is observed, but it has a low R^2 (0.0438) which means that it has little explanatory power.

In general, they all showed that the available phosphorus content is only correlated with the soil being in the pH 5 to 6, and near-neutral and alkaline conditions were not correlated in a significant way. The low R^2 values at other pH regimes indicate that factors other than pH also contribute substantially to the control of phosphorus in soils. The findings have made it clear that the pH of the soil should be at a range of 5-6 to obtain a greater amount in an available form.

DISCUSSION

The present research proposes that the availability of phosphorus (P) in different pH regimes and conditions is greatly yet inconsistently affected by soil pH. Although trends exist, the overall low coefficients of determination (R^2) imply that there are many interacting parameters of soil, and pH cannot explain the variability of available phosphorus entirely (Table 1).

pH and accessible phosphorus in acidic soils (pH 3-5) have a modest negative relationship. Phosphorus also forms highly insoluble compounds that drastically reduce the availability of P in acidic soils as it becomes precipitated and adsorbed to the surface (Pollution Sustainability Directory, 2025; Brady and Weil, 2002). The mechanism has been widely reported in past studies, including Vance et al. (2003) and Hinsinger (2001) who noted that high sorption and precipitation reactions in acidic soils is often a limiting factor in the availability of phosphorus.

Soluble orthophosphate (primarily) combines in very insoluble Al–P and Fe–P minerals like variscite ($AlPO_4.2H_2O$) and strengite ($FePO_4.2H_2O$) in a strongly acidic environment (pH below 5 -5.5) with dissolved Al^{3+} and Fe^{3+}. These effectively bind P into non soluble forms, which greatly reduce the amount of plant available P in the soil solution (Pollution Sustainability Directory, 2025).

Hydrated iron and aluminium oxides and hydroxides (e.g., goethite, gibbsite, and amorphous Fe oxides) are also common in acid soils, and contain positively charged surface sites at low pH (Brady and Weil, 2002). Phosphate anions bind through ligand exchange reactions where surface OH^- or H_2O groups are replaced and strong inner sphere complexes form on Fe and Al oxide surfaces, which further immobilise P (Pollution Sustainability Directory, 2025).

Between pH 5 and 6, a comparatively high-positive correlation (r = 0.389) was found, which implies that phosphorus availability increases as pH increases. It is explained by the fact that Fe and Al activity decreases with the increase in soil pH, resulting in less fixation and high solubility of phosphorus (Penn and Camberato, 2019). The same has been observed by Richardson et al. (2009)

who reported that moderate pH conditions increase phosphorus availability by both chemical and biological mechanisms such as microbial mineralisation and root induced solubilisation.

The insignificant correlation that was found in this paper in the near-neutral soils (6-7) indicates that the level of phosphorus availability has reached a relatively stable point. At this pH range, the balance between phosphorus fixation and release is optimal, resulting in maximum plant-available forms ($H_2PO_4^-$ and HPO_4^{2-}). This observation aligns with soil chemistry principles described by Brady and Weil (2002), who reported that phosphorus availability is generally highest in soils with a pH between 6.0 and 7.5.

In alkaline soils (pH > 7), the weak and inconsistent relationships observed in this study can be explained by the precipitation of phosphorus with calcium (Ca^{2+}), forming calcium phosphate (such as monocalcium phosphate and dicalcium phosphate) (Nancollas & Zawacki, 1989). Under high pH and high supersaturation, amorphous calcium phosphate (ACP) phase is often formed first and then converted into crystalline phases, including octacalcium phosphate (OCP; $Ca_8H_2(PO_4)_6.5H_2O$) and, finally, hydroxyapatite (HAP; $Ca_{10}(PO_4)_6(OH)_2$) (Cerozi & Fitzsimmons, 2017).

This makes phosphorus less soluble even though it is contained in the soil. Nevertheless, the variation and low correlations imply that other variables, including soil texture, or organic matter content, and microbial activity could play a major role in the dynamics of phosphorus in alkaline environments. These studies show that complex interactions tend to dominate the phosphorus behaviour in alkaline soils and not pH alone (Holford 1997).

The low values of R^2 throughout the pH ranges also point to the fact that availability of phosphorus is a multifactorial process. Other than pH, soil minerology, content of organic matter, activity of microbes and root exudates are other factors that are necessary to influence phosphorus availability. As an example, the significance of phosphatase enzymes and microbial activity in mobilisation of organic phosphorus in soils, especially in nutrient-limiting circumstances, has been illustrated by Tarafdar J. C. and Claassen (1988).

CONCLUSION

The results of the present work support the idea that maintaining the soil pH close to neutral is beneficial for improving phosphorus uptake by plants. The use of soil pH as a regulator of phosphorus availability is not to be taken alone. The combination of chemical and biological-based soil management approaches is necessary to enhance the efficiency of phosphorus use, particularly in arid and semi-arid areas where nutrient constraints are widespread.

Table 1. Correlation (r) and Coefficient of Determination (R^2) between Soil pH Ranges and Available Phosphorus

Soil pH	Correlation value (r)	Coefficient of Determination (R^2)
Between 3 and 5	-0.210^{NS}	0.044
Between 5 and 6	0.389*	0.1512
Between 6 and 7	0.024^{NS}	0.0006
Between 7 and 8	-0.053^{NS}	0.0028
Between 8 and 9	0.046^{NS}	0.0021
Between 9 and 10	-0.209^{NS}	0.0438

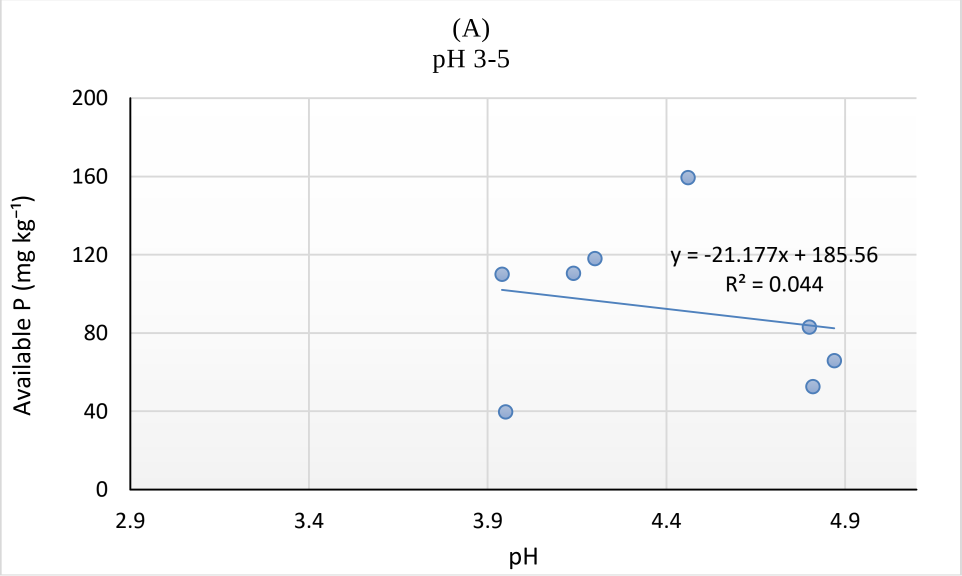
*p <0.05; NS: Non-significant

Table 2. Effect of Soil pH on Phosphorus Availability Across a Wide pH Range (3.0–10.0)

Soil No.	**Soil pH**	**Available P (mg kg⁻¹)**	Soil No.	**Soil pH**	**Available P (mg kg⁻¹)**	**Soil No.**	**Soil pH**	**Available P (mg kg⁻¹)**	**Soil No.**	**Soil pH**	**Available P (mg kg⁻¹)**
A. Soil pH between 3 and 5			64	6.5	36.63 ± 2.11	129	7.65	13.47 ± 0.75	194	8.51	4.73 ± 0.35
1	3.95	39.73 ± 2.37	65	6.38	36.10 ± 1.95	130	7.82	8.33 ± 0.45	195	8.5	4.83 ± 0.35
2	3.94	110.05 ± 8.27	66	6.11	84.37 ± 3.18	131	7.74	94.83 ± 3.55	196	8	4.20 ± 0.36
3	4.46	159.47 ± 10.07	67	6.22	6.63 ± 0.50	132	7.72	8.53 ± 0.45	197	8.5	7.60 ± 0.50
4	4.2	118.15 ± 11.09	68	6.16	42.07 ± 2.08	133	7.35	4.27 ± 0.35	198	8.08	3.23 ± 0.25
5	4.81	52.60 ± 3.40	69	6.15	21.57 ± 1.21	134	7.04	85.20 ± 3.10	199	8.01	37.37 ± 1.72
6	4.14	110.63 ± 14.41	70	6.11	32.87 ± 2.18	135	7.61	59.47 ± 2.65	200	8.12	26.97 ± 1.20
7	4.8	83.13 ± 7.50	71	6.32	29.90 ± 1.95	136	7.25	31.83 ± 1.70	201	8.1	6.17 ± 0.40
8	4.87	65.93 ± 5.36	72	6.27	82.47 ± 3.31	137	7.15	22.03 ± 1.10	202	8.15	3.17 ± 0.25
B. Soil pH between 5 and 6			73	6.42	133.07 ± 4.91	138	7.95	35.23 ± 1.86	203	8.01	4.43 ± 0.35
9	5.55	37.27 ± 2.40	74	6.26	84.60 ± 3.35	139	7.45	184.83 ± 6.44	204	8.14	2.83 ± 0.25
10	5.98	181.73 ± 6.04	75	6.66	144.77 ± 4.77	140	7.03	78.13 ± 3.01	205	8.04	25.90 ± 1.21
11	5.94	186.57 ± 5.58	76	6.64	131.10 ± 4.22	141	7.19	49.57 ± 2.05	206	8.2	5.37 ± 0.40
12	5.6	204.53 ± 5.65	77	6.25	209.57 ± 6.71	142	7.58	28.07 ± 1.52	207	8.16	6.63 ± 0.40
13	5.52	124.73 ± 3.96	78	6.32	79.07 ± 3.04	143	7.32	19.33 ± 1.06	208	8.14	3.30 ± 0.30
14	5.35	47.63 ± 1.63	79	6.52	31.77 ± 1.80	144	7.66	65.57 ± 2.70	209	8.42	2.63 ± 0.25
15	5.5	56.50 ± 2.00	80	6.76	162.60 ± 6.20	145	7.5	34.23 ± 1.76	210	8.38	5.37 ± 0.40
16	5.72	29.17 ± 1.17	**D. Soil pH between 7 and 8**			146	7.61	59.90 ± 2.65	211	8.26	5.07 ± 0.40
17	5.55	44.87 ± 1.62	81	7.83	98.40 ± 2.84	147	7.76	32.40 ± 1.71	212	8.17	8.83 ± 0.55

18	5.11	18.53 ± 0.76	82	7.92	16.30 ± 0.90	148	7.69	276.27 ± 10.10	213	8.18	3.00 ± 0.30
19	5.55	46.10 ± 1.42	83	7.74	116.50 ± 3.95	149	7.09	133.23 ± 4.93	214	8.12	4.60 ± 0.40
20	5.72	33.83 ± 1.12	84	7.97	22.73 ± 1.20	150	7.37	61.73 ± 2.70	215	8.2	3.30 ± 0.26
21	5.5	60.00 ± 2.07	85	7.76	24.63 ± 1.30	151	7.54	15.63 ± 0.85	216	8.37	73.97 ± 3.00
22	5.35	51.17 ± 1.67	86	7.44	50.83 ± 1.98	152	7.6	78.23 ± 3.11	217	8.37	100.57 ± 4.41
23	5.52	124.73 ± 3.25	87	7.6	13.67 ± 0.75	153	7.45	78.87 ± 3.20	218	8.29	115.53 ± 4.50
24	5.6	214.28 ± 6.46	88	7.71	10.57 ± 0.60	154	7.1	67.23 ± 3.07	219	8.08	9.77 ± 0.60
25	5.94	186.57 ± 4.90	89	7.32	19.13 ± 1.05	155	7.83	39.47 ± 1.76	220	8.43	40.33 ± 1.90
26	5.55	36.60 ± 1.31	90	7.33	18.00 ± 0.95	156	7.99	31.27 ± 1.72	221	8.41	18.93 ± 1.05
27	5.98	187.37 ± 5.10	91	7.4	9.57 ± 0.55	167	7.98	18.93 ± 1.05	222	8.89	11.60 ± 0.66
28	5.82	43.03 ± 1.48	92	7.44	219.33 ± 7.33	158	7.82	73.23 ± 3.11	223	8.16	56.83 ± 2.35
29	5.95	7.23 ± 0.35	93	7.78	54.10 ± 2.10	159	7.59	77.07 ± 3.20	224	8.13	21.80 ± 1.05
30	5.57	8.53 ± 0.40	94	7.92	13.27 ± 0.75	160	7.77	40.10 ± 1.85	225	8.05	27.80 ± 1.41
31	5.13	14.67 ± 0.61	95	7.17	22.10 ± 1.10	161	7.63	35.17 ± 1.70	226	8.22	14.67 ± 0.80
32	5.8	141.80 ± 4.64	96	7.14	8.20 ± 0.50	162	7.66	48.03 ± 2.00	227	8.3	16.27 ± 0.86
33	5.54	200.47 ± 5.67	97	7.8	62.50 ± 2.46	163	7.64	43.57 ± 1.91	228	8.58	10.10 ± 0.56
34	5.74	204.17 ± 5.24	98	7.55	7.60 ± 0.40	164	7.62	39.03 ± 1.80	229	8.4	8.67 ± 0.60
35	5.11	18.53 ± 0.60	99	7.34	4.43 ± 0.31	165	7.82	37.60 ± 1.81	230	8.33	52.63 ± 2.26
36	5.66	9.17 ± 0.35	100	7.54	83.50 ± 3.28	166	7.2	24.23 ± 1.25	231	8.62	38.20 ± 1.81
37	5.94	92.20 ± 3.21	101	7.77	19.03 ± 1.05	167	7.04	90.07 ± 3.50	232	8.15	28.40 ± 1.40
38	5.82	16.43 ± 0.57	102	7.68	13.17 ± 0.85	168	7.61	63.07 ± 2.75	233	8.17	18.30 ± 0.95
39	5.7	44.20 ± 1.57	103	7.11	19.57 ± 1.00	169	7.25	32.13 ± 1.65	234	8.12	19.57 ± 1.00
40	5.71	50.53 ± 1.75	104	7.11	17.03 ± 0.90	170	7.15	24.73 ± 1.25	235	8.51	50.53 ± 2.12
41	5.1	73.57 ± 2.66	105	7.32	6.40 ± 0.40	171	7.45	184.83 ± 6.03	236	8.15	24.13 ± 1.15
42	5.2	67.87 ± 2.40	106	7.5	117.47 ± 4.02	172	7.03	78.13 ± 2.90	**F. Soil Ph between 9 and 10**		
43	5.62	204.53 ± 5.27	107	7.67	111.23 ± 3.87	173	7.19	54.83 ± 2.35	237	9.03	46.87 ± 1.65
44	5.76	32.57 ± 1.11	108	7.79	241.03 ± 8.14	174	7.58	31.37 ± 1.66	238	9.04	24.83 ± 1.05
45	5.92	233.67 ± 6.68	109	7.49	145.33 ± 4.96	175	7.32	23.10 ± 1.15	239	9.21	33.63 1.46
C. Soil pH between 6 and 7			110	7.69	207.97 ± 7.07	176	7.66	65.07 ± 2.91	240	9.36	24.57 ± 1.05
46	6.55	182.97 ± 5.32	111	7.4	149.87 ± 5.46	**E. Soil pH between 8 and 9**			241	9.01	24.23 ± 1.17
47	6.83	52.97 ± 3.45	112	7.05	230.80 ± 8.09	177	8.42	13.27 ± 0.78	242	9.14	37.20 ± 1.65
48	6.72	247.00 ± 10.68	113	7.61	207.13 ± 7.20	178	8.22	13.57 ± 0.76	243	9.21	22.30 ± 1.15
49	6.55	92.30 ± 2.44	114	7.22	104.70 ± 3.75	179	8.07	13.43 ± 0.70	244	9.01	32.00 ± 1.67
50	6.66	62.53 ± 5.70	115	7.39	224.90 ± 8.09	180	8.04	11.07 ± 0.64	245	9.3	25.13 ± 1.21
51	6.18	61.80 ± 5.29	116	7.75	201.53 ± 6.99	181	8	17.67 ± 0.80	246	9.04	27.17 ± 1.26
52	6.88	40.53 ± 2.35	117	7.29	116.93 ± 4.44	182	8.15	12.13 ± 0.71	247	9.15	34.27 ± 1.65
53	6.86	28.20 ± 1.40	118	7.89	105.17 ± 3.89	183	8.12	15.43 ± 0.71	248	9.07	27.17 ± 1.06
54	6.97	3.13 ± 0.31	119	7.7	46.50 ± 1.91	184	8.28	23.37 ± 1.06	249	9.14	40.73 ± 1.80
55	6.35	22.73 ± 1.53	120	7.59	63.30 ± 2.66	185	8.01	10.77 ± 0.60	250	9.15	25.23 ± 1.25
56	6.82	103.53 ± 3.50	121	7.24	9.37 ± 0.50	186	8.33	12.53 ± 0.65	251	9.22	22.30 ± 1.35
57	6.58	7.57 ± 0.49	122	7.66	121.23 ± 4.79	187	8.24	6.30 ± 0.36	252	9.38	14.57 ± 0.75
58	6.3	4.63 ± 0.31	123	7.44	20.80 ± 1.10	188	8.09	16.43 ± 0.76	253	9.01	22.30 ± 1.25
59	6.96	11.67 ± 0.76	124	7.78	18.03 ± 1.00	189	8.17	10.13 ± 0.61	254	9.1	14.50 ± 0.75
60	6.62	13.17 ± 0.81	125	7.7	10.93 ± 0.65	190	8.05	112.37 ± 4.02	255	9.2	26.17 ± 1.40
61	6.96	46.50 ± 2.29	126	7.75	10.90 ± 0.66	191	8.1	84.73 ± 3.61	256	9.04	13.77 ± 0.80
62	6.95	36.23 ± 1.94	127	7.63	7.57 ± 0.45	192	8.09	16.43 ± 0.78			
63	6.26	57.40 ± 2.42	128	7.93	5.07 ± 0.35	193	8.1	9.07 ± 0.50			

± indicates the standard errors of mean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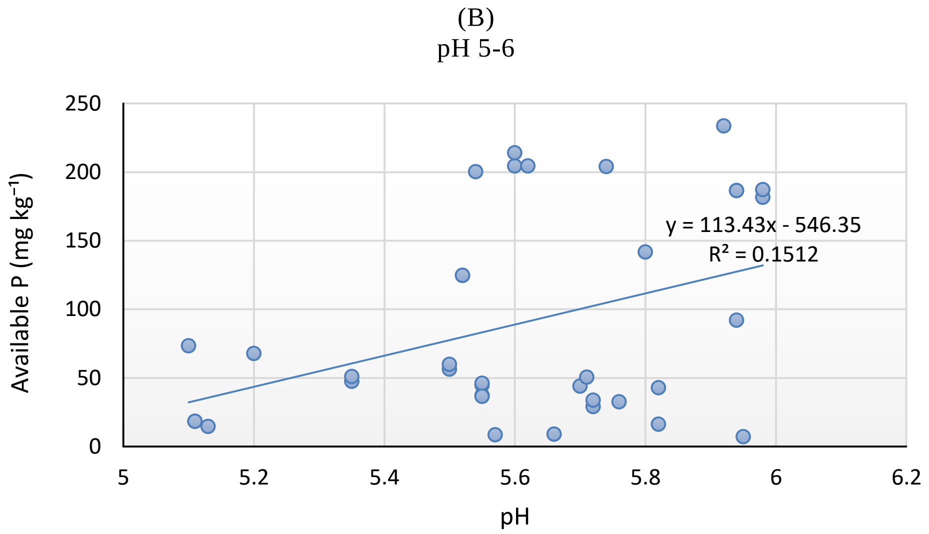
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pH 5-6

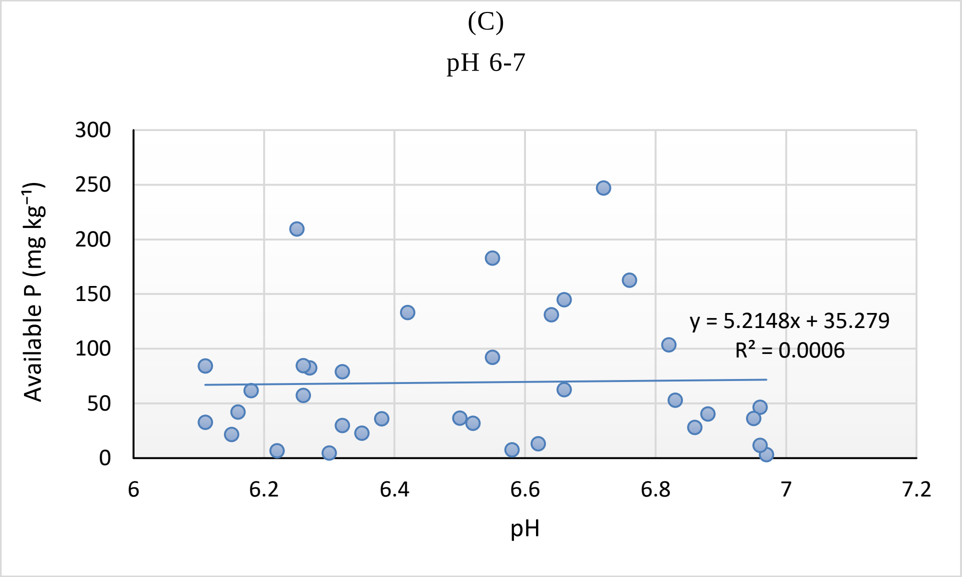
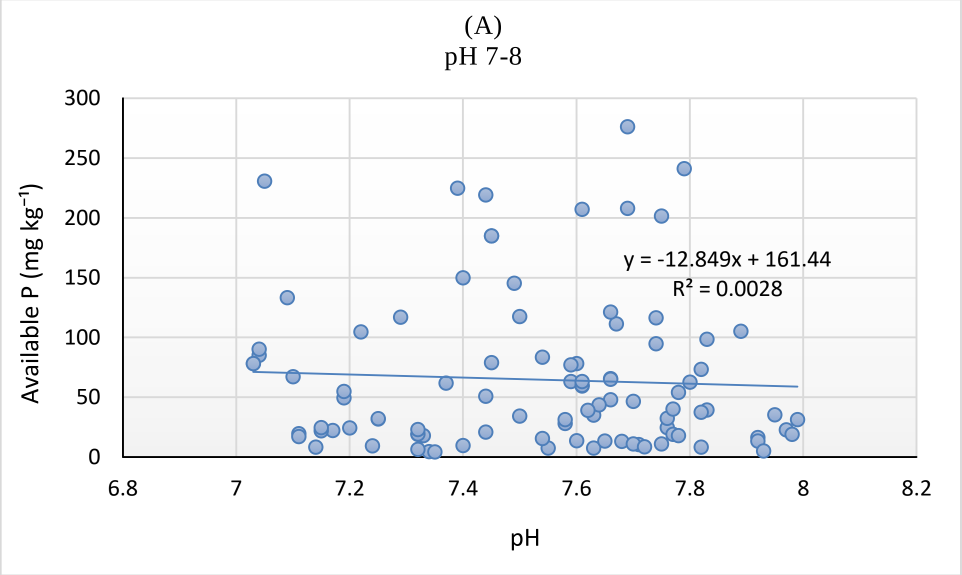

(C)
pH 6-7

Fig. 1. Relation between available phosphorus and soil pH (3-7)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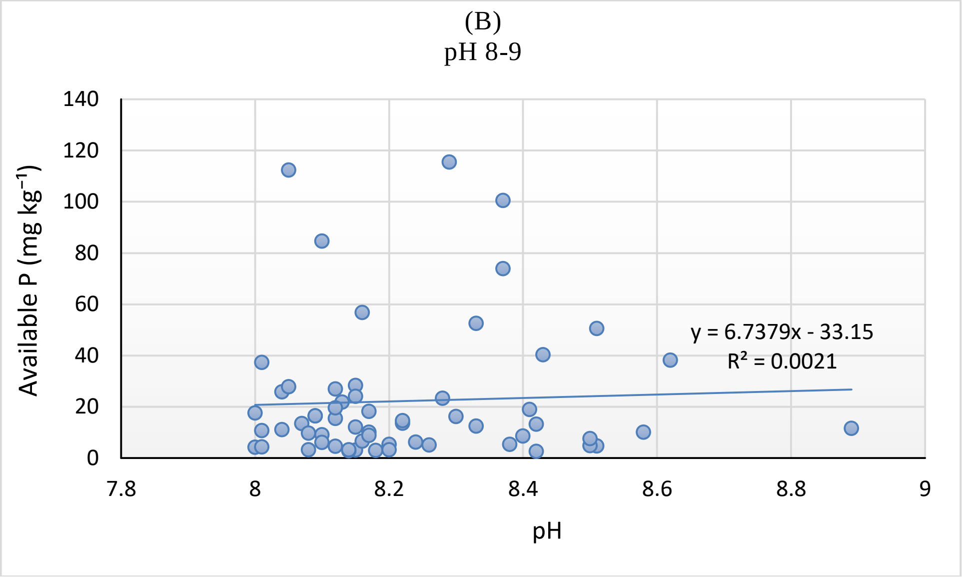

(B)
pH 8-9

(C)
pH 9-10

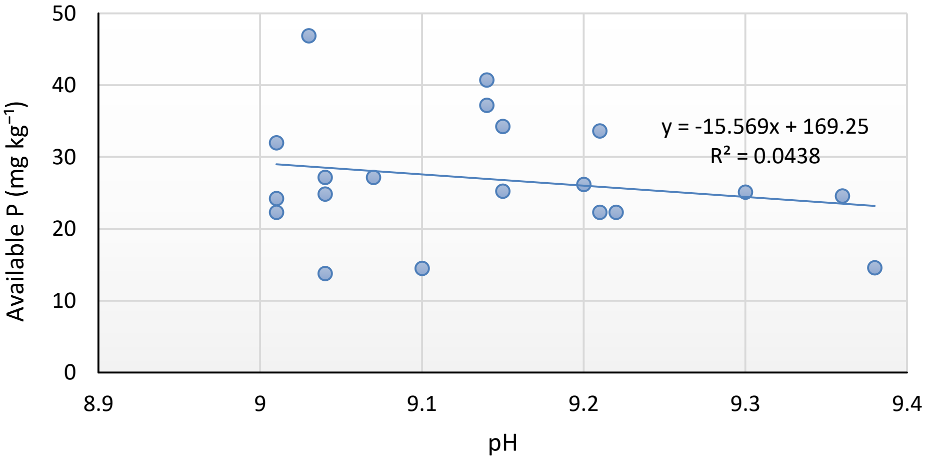

Fig.2 Relation between available phosphorus and soil pH (7-10)

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