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Dynamics of phosphorus under different soils of wheat growing area of Sindkhed Raja Tehsil in Buldhana district

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Abstract
The present investigation in relation to "Dynamics of phosphorus under different soils of wheat growing area of Sindkhed Raja Tehsil in Buldhana district" was under taken during 2020-2021. 50 farmers were selected from 12 different villages in Sindkhed Raja Tehsil. Surface soil (0-15 cm) samples were collected for analysis from sites. When analysed before sowing, the soil of Sindkhed Raja Tehsil were Aluminium bound phosphorus of before sowing of wheat crop is ranged from 2.91 ppm to 4.16 ppm and after harvest of wheat aluminium bound phosphorus ranged varied from 3 ppm to 4.22 ppm. Saloid bound phosphorus of before sowing of wheat crop is ranged from 28.35 ppm to 36.81 ppm and after harvest ranged varied from 28.74 ppm to 37.32 ppm. Iron bound phosphorus before sowing ranged from 18.83 ppm to 24.45 ppm and after harvest ranged varied from 19.09 ppm to 24.79 ppm. Reductant phosphorus before sowing of wheat crop is ranged from 26.90 ppm to 34.92 ppm and after harvest ranged varied from 27.27 ppm to 35.41 ppm. Occluded phosphorus before sowing of wheat crop ranged from 151.44 ppm to 209.73 ppm and after harvest ranged varied from 153.53 ppm to 212.63 ppm. Calcium bound phosphorus before sowing of wheat crop is ranged from 12.04 ppm to 19.49 ppm and after harvest varied from 12.21 ppm to 19.76 ppm. Organic phosphorus before sowing of wheat crop is ranged from 187.95 ppm to 263.66 ppm and after harvest it varied from 194.99 ppm to 248.17 ppm. Total phosphorus before sowing of wheat crop ranged from 444.10 ppm to 565.35 ppm and after harvest it varied from 452.50 ppm to 579.52 ppm. It was observed that grain yield increases as fraction increases, hence; all the forms of phosphorus were highly significant and positively correlated with yield of wheat.

Keywords: Dynamics, phosphorus under, soils, wheat growing

Introduction
Phosphorus is one of the essential nutrient elements and present in to substantial quantities in most of the Indian soils. Most of Indian soils are reported (Ghani and aleem 1943) [1] to be rich in total phosphorus content but are poor in their availability. The freshly applied phosphate is utilised by crop plants rest goes into the formation of different P compound of varying solubility which later serve as potential sources of P for plants (Kanwar, 1976) [3].

Phosphorus, like any other plant nutrient is present in soil in two major components i.e., organic and inorganic P, which is mainly confined to the surface layer, is mineralized into inorganic forms but, the plants mainly depend on inorganic P forms for their P requirements. Saloid-P, Al-P, Fe-P and Ca-P fractions are the main source of P supply to the plants.

The relative proportion of different forms of inorganic phosphorus depends on various soil characteristics like pH, organic carbon, $CaCO_3$, CEC and texture (Jaggi, 1991) [4]. Phosphorus is the backbone of balanced fertilization in Indian agriculture. Information on P fertility status of soils is of great importance as it helps to determine the level of P fertilizer to be applied to crops and decide on fertilizer distribution and planning at macro and micro levels. The present study was undertaken to assess the status of different forms of phosphorus in Sindkhed raja Tehsil in Buldhana district.

Materials and Methods
The research work was carried out during 2020-21. 50 farmers were selected from 12 different villages in Sindkhed Raja Tehsil viz. Deulgaon Kol, Konati, Kumbefal, Shendurjan, Dusarbid, Kingaon Raja, Pimpalgaon, Zotinga, Sakharkherda, Ambewadi, Agefal and Linga. Surface soil samples (0-15 cm) were taken from 50 different farmer's fields before sowing of wheat and after harvesting of wheat. The processed soil samples were analyzed different P fractions by adopting standard procedures. Total phosphorus in soil was determined using 60% perchloric

acid digestion method as suggested by piper (1966) [6]. The original fractionation procedure for different forms of inorganic P proposed by Peterson and Coney (1966) [5] and available P by Olsen et al., (1954) [10] were used. Organic P was determining as the difference between total P and total inorganic P.

Result and Discussion

Phosphorus is considered to be the second most limiting nutrient in crop species. Furthermore, little information exists in the effect of manure and P application on the distribution of P within inorganic and organic pools. Phosphorus fraction in soil provides an alternative for characterizing soil phosphorus availability without quantifying the component of P. Phosphorus is one of the essential nutrient elements and present in to substantial quantities in most of the Indian soils. Phosphorus is the backbone of balanced fertilization in Indian agriculture.

a) Aluminium-P

Aluminium-P is loosely bound phosphorus the aluminium-P in 50 samples before sowing varies from 2.91 ppm to 4.16 ppm the lowest value for aluminium-P before sowing of wheat crop was found in Konati village in sample number 8 with value of 2.91 ppm. Highest value for aluminium-P phosphorus was recorded in sample number 45 from village Agefal. There is slight increase in aluminium-P fraction after harvest of wheat crop. The aluminium-P range from 3 ppm to 4.22 ppm after harvest of wheat crop. The lowest aluminium P was found in sample number 1 from Deulgaon kol village and sample number 45 from Agefal village recorded highest aluminium-P with the value of 4.22 ppm.

Aluminium bound Phosphorus did not show much response to fertilization but in general it was found that, where application of organic manure is practiced have shown increased value for aluminium bound phosphorus. Also, it was observed that, as the organic carbon content increases aluminium bound phosphorus also increases. Patle *et. al.,* (2019) [7] also reported that, aluminium bound phosphorus was presents in smaller quantity compared to other Phosphorus fractions.

b) Saloid-P

Saloid bound phosphorus was comprising of about 6.5 % of total phosphorus. Saloid bound fraction of phosphorus varied slightly in soil samples before sowing and after harvesting of wheat. The values for this fraction ranged from 28.35 ppm to 36.81 ppm before sowing of wheat crop. The lowest saloid bound phosphorus was found in Kumbefal village in sample number 14. The highest value for saloid bound phosphorus after harvest of wheat was found in Konati village in sample number 7.

Soil samples for determination of saloid bound phosphorus after harvest of wheat were processed and found that, there is negligible changes in this fraction compared to before sowing. The values for saloid bound phosphorus after harvest of wheat crop ranged from 28.74 ppm to 37.32 ppm the lowest saloid bound phosphorus after harvest of wheat crop was recorded in Kumbefal for village in sample number 13 whereas, highest value was recorded in Konati village with 37.32 ppm of saloid bound phosphorus. Soremi 2017 [8], also reported that, availability of soil phosphorus is a function of its dynamics and can be improved by using balance fertilization with inorganic as well as well as organic source of nutrients.

c) Iron bound phosphorus

Iron bound phosphorus comprise of about 4% of total phosphorus. There is slight or no variation in values of iron bound phosphorus before sowing and after harvest of wheat crop. It was found that, iron bound phosphorus varied from 18.83 ppm to 24.45ppm before sowing of wheat crop. The lowest value for iron bound phosphorus was recorded in Pimpalgaon village in sample number 2 with value of 18.83 ppm and sample number 33 is from Konati village recorded 24.45 ppm of iron bound phosphorus which was highest among all 50 samples. After harvest of wheat ironbound phosphorus ranged from 19.09 ppm to 24.79 ppm. Lowest value of iron bound phosphorus after harvest of wheat was recorded in sample number 4, 13 and 28 from Deulgaon kol, Kumbefal and Pimpalgaon village and highest for Zotinga village Sample number 32.

It was observe that, iron bound phosphorus fraction increased where phosphorus application is done in the soils where phosphorus is not applied showing less values for iron bound phosphorus. It clearly indicates that the fractions increases when there is input of phosphorus in the form of fertilizers or manures. The results are in conformity with Viswanath and Dodamani 1991 [9], who observed that, ironbound phosphorus increases due to higher organic carbon content and proper fertilization.

d) Reductant-P

Reductant phosphorus is an inactive form of phosphorus. In these 50 samples reductant phosphorus fraction consists of about 6% of total phosphorus content of soil. Before sowing of wheat crop reductant phosphorus varied from 26.90 ppm to 34.92 ppm the lowest values of 26.90 ppm was recorded in Deulgaon kol and Shendurjan village respectively in sample number 2 and 14 and sample number 23 and 28 from village Kingaon Raja and Pimpalgaon recorded highest value for reductant phosphorus.

After harvest of wheat the values for reductant phosphorus from 50 samples varied from 27.27 ppm to 35.41 ppm. Lowest value of reductant phosphorus was recorded in in sample number 4, 13 and 28 from villages Deulgaon kol, Kumbefal for and Pimpalgaon respectively. Whereas 35.41 ppm which was highest value for reductant phosphorus was recorded in sample numbers 18, 23 and 24 from villages Shendurjan and Kingaon raja respectively. Regarding reductant phosphorus also it was found that incorporation of organic manures along with inorganic fertilizers boosted the content of this fraction in soil the results are in conformity with Soremi *et. al*., 2017 [8].

e) Occluded-P

The amount and distribution of occluded form of phosphorus is shown in Table 1 and 2 before sowing of wheat and after harvest of wheat. The occluded phosphorus on average was about 18.62 ppm. It contributed about 36.31 per cent of total phosphorus content of soil. Among 50 villages occluded phosphorus fraction varied from 151.44 ppm to 209.73 ppm before sowing of wheat crop and lowest content recorded in Shendurjan village in sample number 14. The highest occluded phosphorus content was recorded in Kingaon Raja village with sample number 23 and 24.

Slight variation was observed in occluded phosphorus content of soil from before sowing to after harvest of wheat. After harvest of wheat the soil was containing 225.12 ppm of

occluded phosphorus. It consists of about 36% of total phosphorus content of the soil sample highest occluded phosphorus content after harvest of wheat ranged from 153.53 ppm to 212. 63 ppm. The lowest occluded phosphorus was observed in Shendurjan village in sample number 14 with 153.53 ppm. Kingaon raja recorded highest occluded phosphorus content in sample numbers 23 and 24 with 212.63 ppm occluded phosphorus content.

f) Calcium-P

Distribution of calcium bound phosphorus in 50 samples collected from Sindkhed Raja Tehsil before sowing and after harvest of wheat is presented in Table number 1 and 2. On an average about 16.07 ppm of calcium bound phosphorus was present in 50 samples before sowing of wheat crop. It constituted about 6%. Calcium bound phosphorus varied from 12.04 ppm to 19.49 ppm before sowing of wheat crop the lowest calcium bound phosphorus was recorded in sample number 18 which 12.04 ppm the highest calcium bound phosphorus was found to be 19.49 ppm before sowing of wheat crop in sample number 10 from Kumbefal village.

After harvest of wheat, calcium bound phosphorus was found to be 3.2 per cent of total phosphorus content it was present upto 16.07 ppm in the soils of experimental area. The calcium bound phosphorus after harvest of wheat crop ranged from 12.21 ppm to 19.76 ppm. The lowest calcium bound phosphorus was recorded in sample number 18 from Shendurjan village whereas 18.62 ppm of calcium bound phosphorus found highest among 50 samples from Kumbefal village.

g) Organic Phosphorus

About 43.21 per cent of total phosphorus in the surface samples of given experimental area were in organic form. On an average organic phosphorus was present up to 225.11 ppm in all 50 samples. Before sowing of wheat crop organic phosphorus among all 50 samples varied from 187.95 ppm to 263.66 ppm. Major variation regarding distribution of organic phosphorus was observed in the study area. The lowest organic phosphorus content of 187.95 ppm was recorded in sample number 13 from Kumbefal village whereas 263.66 ppm of organic phosphorus was recorded in sample number 14 of Shendurjan village which was found to be highest among all 50 samples. Organic bound phosphorus was present up to 220 ppm on an average in all 50 samples and constituted about 43 per cent of total phosphorus present in the soil sample after harvest of wheat highest organic bound phosphorus was recorded in sample numbers 7, 15, 18, 23, 24, 32, 37, 41, 46 and 50 from Konati, Shendurjan, Kingaon Raja, Zotinga, Sakharkherda, Ambewadi, Agefal and Linga villages respectively (table 1 and 2)

In before sowing of wheat and after harvest of wheat crop the organic bound phosphorus was found to be major fraction among all other phosphorus fraction estimated not much variation is seen in the values of organic bound phosphorus with application of organic manures or inorganic fertilizers.

h) Total -P

As shown in Tables 1 and 2 the total phosphorus content in the study area varied from 444.10 ppm to 579.52 ppm before sowing and after harvest of wheat crop. Before sowing there was 520.95 ppm of total phosphorus on an average in all 50 samples from Sindkhed Raja Tehsil and ranges from 444.10 to 565.35 ppm. The lowest total phosphorus content recorded in sample number 8 and 28 from Konati village and Pimpalgaon village. The highest content of total phosphorus was recorded in sample number 18, 41 and 46 from Shendurjan, Ambewadi and Agefal villages respectively. From Table number 2 it was found that, total phosphorus content of experimental area after harvest of wheat crop ranged from 452.50 ppm to 579.52 ppm. Lowest total phosphorus content was recorded in sample number 28 from Pimpalgaon village whereas sample number 23 and 24 from Kingaon Raja village recorded 579.52ppm of total phosphorus content which was found to be highest among all 50 samples.

From Table number 1 and 2 it is evident that total phosphorus before sowing and after harvest of wheat crop range from 444.10 to 579.35 ppm. Available phosphorus in the experimental area was also found in low to medium range. This might be the reason that, total phosphorus content of these soils is low. The results are in conformity with (Kabata Pendias and Pendias 1992) [2], who published that, total phosphorus contain of normal soils vary from 100 ppm to 2000 ppm.

Table 1: Different forms of phosphorus before sowing of wheat growing area of Sindkhed Raja Tehsil in Buldhana district

Sample no.	Aluminium-P	Phosphorus fractions (mg kg^{-1})						
		Saloid-P	Iron-P	Reductant-P	Calcium-P	Occluded-P	Organic-P	Total-P
1	2.96	31.21	20.54	29.34	13.02	178.01	209.33	484.41
2	3.08	32.15	22.25	31.79	12.63	192.84	229.59	524.67
3	3.39	31.55	20.54	29.34	15.74	178.01	205.95	484.53
4	3.44	28.92	18.83	26.90	14.43	163.17	188.82	444.15
5	3.17	31.55	20.96	29.34	15.74	178.01	205.76	484.53
6	3.44	33.13	22.70	31.79	17.05	182.98	233.45	524.54
7	3.70	36.81	24.45	34.23	18.37	207.67	240.06	565.29
8	2.91	28.92	19.21	26.90	14.43	163.17	188.62	444.16
9	3.17	31.55	20.96	29.34	14.05	178.01	207.40	484.48
10	3.17	34.18	22.70	31.79	19.49	190.89	222.44	524.93
11	3.44	33.58	20.96	29.34	16.06	176.21	205.23	484.55
12	3.17	30.92	20.54	29.34	16.06	176.21	208.20	484.45
13	3.44	28.35	18.83	26.90	16.74	161.52	187.95	444.18
14	3.89	33.50	22.25	31.79	17.40	151.44	263.66	523.47
15	3.70	36.08	20.02	34.23	18.37	195.71	256.60	564.71
16	3.17	28.95	20.54	30.94	15.74	176.21	208.87	484.43
17	3.44	33.50	22.25	31.42	17.05	190.89	226.23	524.80
18	3.70	36.08	23.96	34.92	12.04	205.58	248.70	564.99

19	3.17	30.92	20.54	29.93	15.74	179.77	204.50	484.58
20	3.24	33.5	22.25	32.43	17.05	194.75	221.54	524.97
21	3.44	30.92	20.54	29.93	15.74	177.80	206.34	484.52
22	3.24	30.92	20.54	29.93	15.74	179.77	204.44	484.59
23	3.78	36.08	23.96	34.92	18.37	209.73	238.51	565.35
24	3.78	36.08	23.96	34.92	18.37	209.73	238.51	565.35
25	3.51	33.50	22.25	31.79	17.05	194.75	222.09	524.94
26	3.24	33.50	22.25	31.79	17.05	190.89	225.82	524.82
27	3.51	30.92	20.54	29.34	15.74	176.21	208.45	484.44
28	3.97	28.35	18.83	26.90	14.43	161.52	190.10	444.10
29	3.51	33.50	22.70	31.79	17.05	190.89	225.38	524.83
30	3.24	33.50	22.70	31.79	17.05	190.89	225.38	524.83
31	3.51	30.92	20.96	29.34	15.74	176.21	208.04	484.45
32	4.06	36.08	24.45	34.23	18.37	205.58	242.72	565.20
33	3.78	30.92	20.96	29.34	15.74	176.21	207.25	484.48
34	3.44	33.50	22.70	31.79	17.05	190.89	225.45	524.83
35	3.44	33.50	22.25	31.79	17.05	190.89	225.88	524.80
36	3.44	33.50	22.25	31.79	17.05	190.89	225.88	524.80
37	3.70	36.08	23.96	34.23	18.37	205.58	243.26	565.18
38	3.17	30.92	20.54	29.34	15.74	176.21	208.50	484.44
39	3.44	33.50	22.25	31.79	17.05	190.89	225.88	524.80
40	3.44	33.50	22.25	31.79	17.05	190.89	225.88	524.80
41	3.7	36.08	23.96	34.23	18.37	205.58	243.26	565.18
42	3.17	30.92	20.54	29.34	15.74	176.21	208.50	484.44
43	3.44	33.50	22.25	31.79	17.05	190.89	225.88	524.80
44	3.44	33.50	22.25	31.79	17.05	190.89	225.88	524.80
45	4.16	30.92	20.54	29.34	15.74	176.21	207.56	484.48
46	3.70	36.08	23.96	34.23	18.37	205.58	243.26	565.18
47	3.44	33.50	22.25	31.79	17.05	190.89	225.88	524.80
48	3.44	33.50	22.25	31.79	17.05	190.89	225.88	524.80
49	3.17	30.92	20.54	29.34	15.74	176.21	208.50	484.44
50	3.70	36.08	23.96	34.23	18.37	205.58	243.26	565.18

Table 2: Different forms of phosphorus after harvesting of wheat growing area of Sindkhed Raja Tehsil in Buldhana district

Sample no.	Yield qt ha^{-1}	Phosphorus fractions mg kg^{-1}							
		Al-P	Saloid-P	Fe-P	Red-P	Calcium- P	Occluded-P	Organic-P	Total-P
1	12	3.00	31.64	20.82	29.75	13.20	180.47	212.43	491.31
2	12	3.48	32.59	22.56	32.23	12.80	195.50	230.44	529.60
3	11	3.44	31.99	20.82	29.75	15.96	180.47	212.72	495.14
4	14	3.12	29.32	19.09	27.27	14.63	165.43	194.99	453.84
5	12	3.22	31.99	21.25	29.75	15.96	180.47	212.72	495.34
6	13	3.48	33.59	23.02	32.23	17.29	185.50	230.44	525.55
7	14	3.75	37.32	24.79	34.71	18.62	210.54	248.17	577.89
8	12	2.95	29.32	19.47	27.27	14.63	165.43	194.99	454.06
9	12	3.22	31.99	21.25	29.75	14.24	180.47	212.72	493.62
10	13	3.48	34.65	23.02	32.23	19.76	193.53	230.44	537.11
11	13	3.22	34.05	21.25	29.75	16.28	178.64	212.72	495.90
12	12	3.22	31.35	20.82	29.75	16.28	178.64	212.72	492.79
13	11	3.95	28.74	19.09	27.27	16.97	163.76	194.99	454.76
14	13	3.48	33.96	22.56	32.23	17.64	153.53	230.44	493.84
15	14	3.75	36.58	20.30	34.71	18.62	198.42	248.17	560.54
16	12	3.22	29.35	20.82	31.37	15.96	178.64	212.72	492.08
17	13	3.48	33.96	22.56	31.86	17.29	193.53	230.44	533.13
18	14	3.75	36.58	24.30	35.41	12.21	208.42	248.17	568.83
19	12	3.22	31.35	20.82	30.35	15.96	182.25	212.72	496.67
20	13	3.48	33.96	22.56	32.88	17.29	197.44	230.44	538.06
21	12	3.28	31.35	20.82	30.35	15.96	180.25	212.72	494.74
22	12	3.28	31.35	20.82	30.35	15.96	182.25	212.72	496.74
23	14	3.83	36.58	24.30	35.41	18.62	212.63	248.17	579.52
24	14	3.83	36.58	24.30	35.41	18.62	212.63	248.17	579.52
25	13	3.56	33.96	22.56	32.23	17.29	197.44	230.44	537.48
26	13	3.56	33.96	22.56	32.23	17.29	193.53	230.44	533.57
27	12	3.28	31.35	20.82	29.75	15.96	178.64	212.72	492.53
28	11	4.03	28.74	19.09	27.27	14.63	163.76	194.99	452.50
29	13	3.56	33.96	23.02	32.23	17.29	193.53	230.44	534.02
30	13	3.56	33.96	23.02	32.23	17.29	193.53	230.44	534.02

31	12	3.28	31.35	21.25	29.75	15.96	178.64	212.72	492.95
32	14	3.83	36.58	24.79	34.71	18.62	208.42	248.17	575.10
33	12	4.12	31.35	21.25	29.75	15.96	178.64	212.72	493.78
34	13	3.48	33.96	23.02	32.23	17.29	193.53	230.44	533.95
35	13	3.48	33.96	22.56	32.23	17.29	193.53	230.44	533.50
36	13	3.48	33.96	22.56	32.23	17.29	193.53	230.44	533.50
37	14	3.75	36.58	24.30	34.71	18.62	208.42	248.17	574.54
38	12	3.22	31.35	20.82	29.75	15.96	178.64	212.72	492.46
39	13	3.48	33.96	22.56	32.23	17.29	193.53	230.44	533.50
40	13	3.48	33.96	22.56	32.23	17.29	193.53	230.44	533.50
41	14	3.75	36.58	24.30	34.71	18.62	208.42	248.17	574.54
42	12	3.22	31.35	20.82	29.75	15.96	178.64	212.72	492.46
43	13	3.48	33.96	22.56	32.23	17.29	193.53	230.44	533.50
44	13	3.48	33.96	22.56	32.23	17.29	193.53	230.44	533.50
45	12	4.22	31.35	20.82	29.75	15.96	178.64	212.72	493.46
46	14	3.75	36.58	24.30	34.71	18.62	208.42	248.17	574.54
47	13	3.48	33.96	22.56	32.23	17.29	193.53	230.44	533.50
48	13	3.48	33.96	22.56	32.23	17.29	193.53	230.44	533.50
49	12	3.22	31.35	20.82	29.75	15.96	178.64	212.72	492.46
50	14	3.75	36.58	24.30	34.71	18.62	208.42	248.17	574.54

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