

Phosphorous Transport in Nanorockphosphate Treated Soils

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Supplementary Material

Materials and Methodology:

Table1. Properties of bulk rock phosphate powder

S. No	Property	Value
1	Average particle size, d_{50} (μm)	12.58
2	Specific surface area (m^2/g)	0.669
3	pH	7.09
4	EC (mS/cm)	3.81
Chemical composition		
1	P_2O_5 (%)	31.00
2	SiO_2 (%)	7-11
3	CaO (%)	45-52
4	MgO (%)	<3
5	Flourine (F) (ppm)	<12500

Table2(a). Designed experimental conditions of wet milling in de-ionized (DI) water.

S. No	Milling speed, rpm	Milling time, hr	BPR	Volume of DI water, ml
1	400	4, 6, 8 and 10	5:1, 7:1, 10:1	20
2	500	4, 6, 8 and 10	5:1, 7:1, 10:1	20
3	600	4, 6, 8 and 10	5:1, 7:1, 10:1	20

Table 2(b) Designed experimental conditions of wet milling in de-ionized (DI) water

S. No	Milling speed, rpm	Milling time, hr	BPR	Volume of ethanol in 20ml DI water, ml
1	500	4 and 6	10:1	0.150, 0.250 and 1

Table 2(c) Designed experimental conditions of wet milling in ethanol

S. No	Milling speed, rpm	Milling time, hr	BPR	Volume of ethanol, ml
1	500	4	10:1, 20:1 and 45:1	10
2	600	4, 6, 8 and 10	10:1, 20:1 and 45:1	10

Table 3. Design of treatments

S.No	Treatment	Application rate, Kg/ha	Dosage, g/column
1	T1 - Control	0	—
2	T2 - SSP	60	0.05
3	T3 - Bulk P	60	0.04
4	T3 - Nano P	60	0.06

Results:

Characterization of Bulk and Nano RP.

Particle size distribution (PSD) of bulk RP

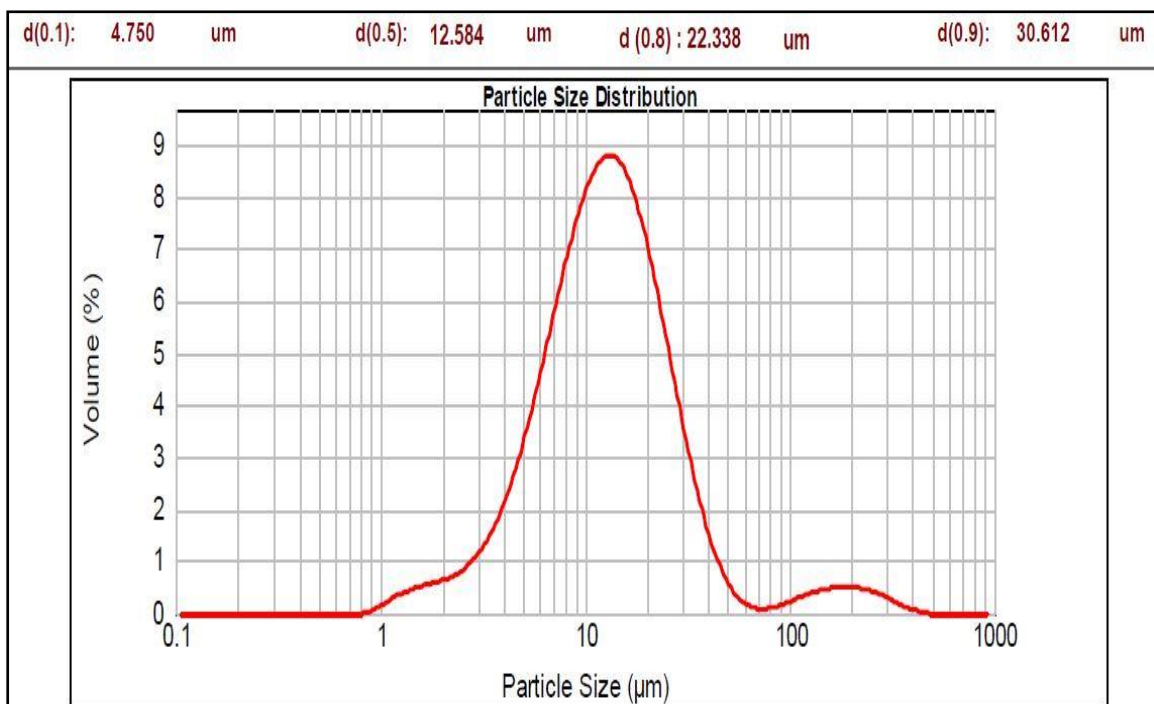


Fig1. PSD of bulk RP

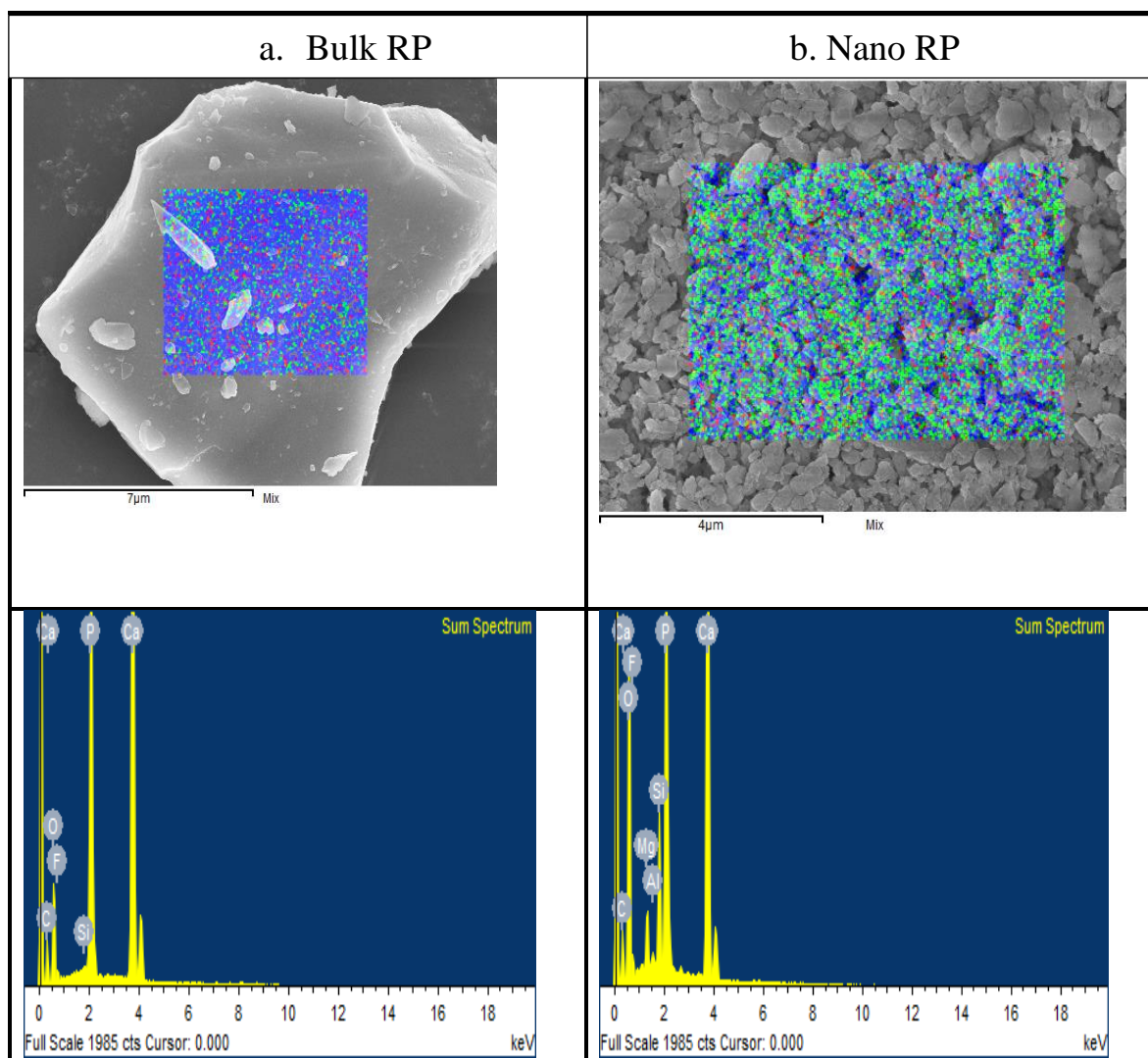


Fig2. Elemental Composition of bulk and nano RP

Table 4. Elemental composition of bulk and nano RP

Bulk RP			Nano RP		
Element	Weight %	Atomic %	Element	Weight %	Atomic %
C	10.67	20.77	C	9.35	15.92
O	24.78	36.21	O	41.28	52.78
F	2.98	3.66	F	4.62	4.98
Si	0.05	0.04	Mg	1.63	1.37
P	20.00	15.09	Al	0.26	0.19
Ca	41.52	24.22	Si	3.89	2.83
			P	13.56	8.96
			Ca	25.42	12.97

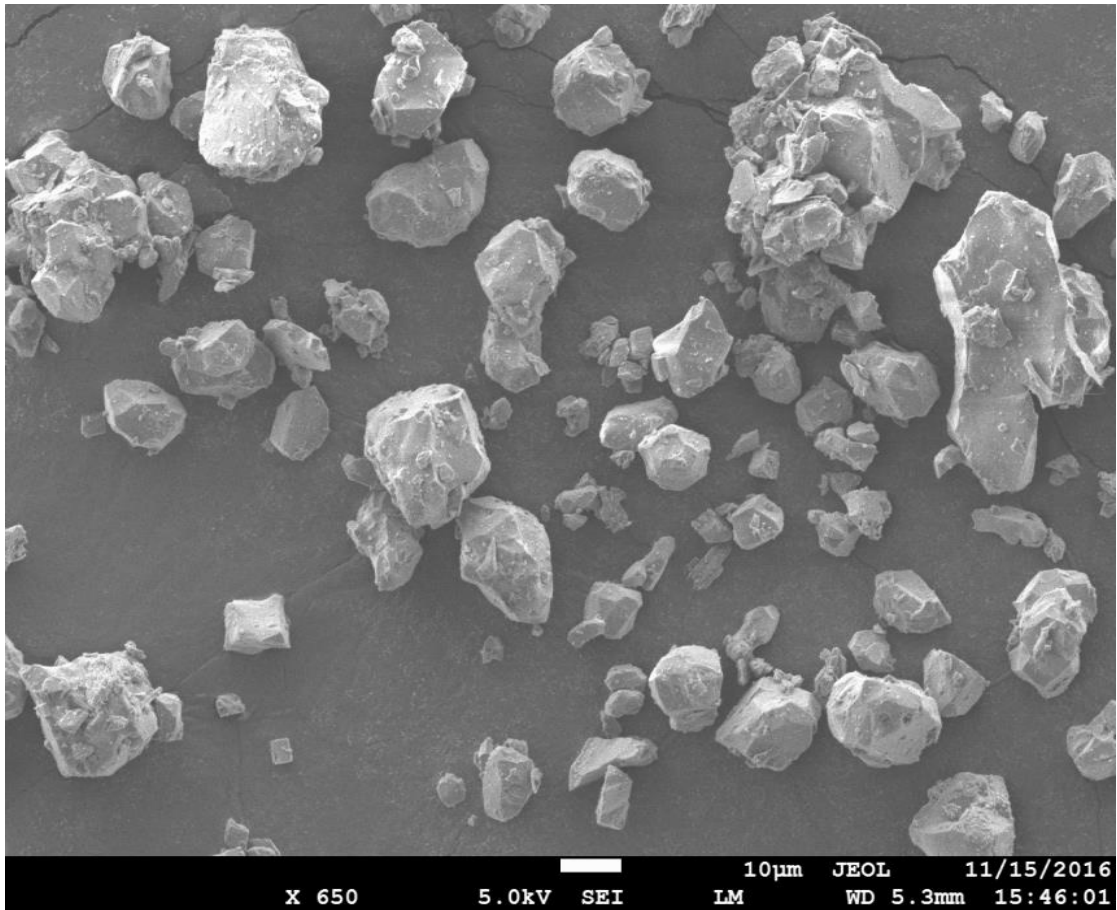


Fig3. SEM image of bulk RP

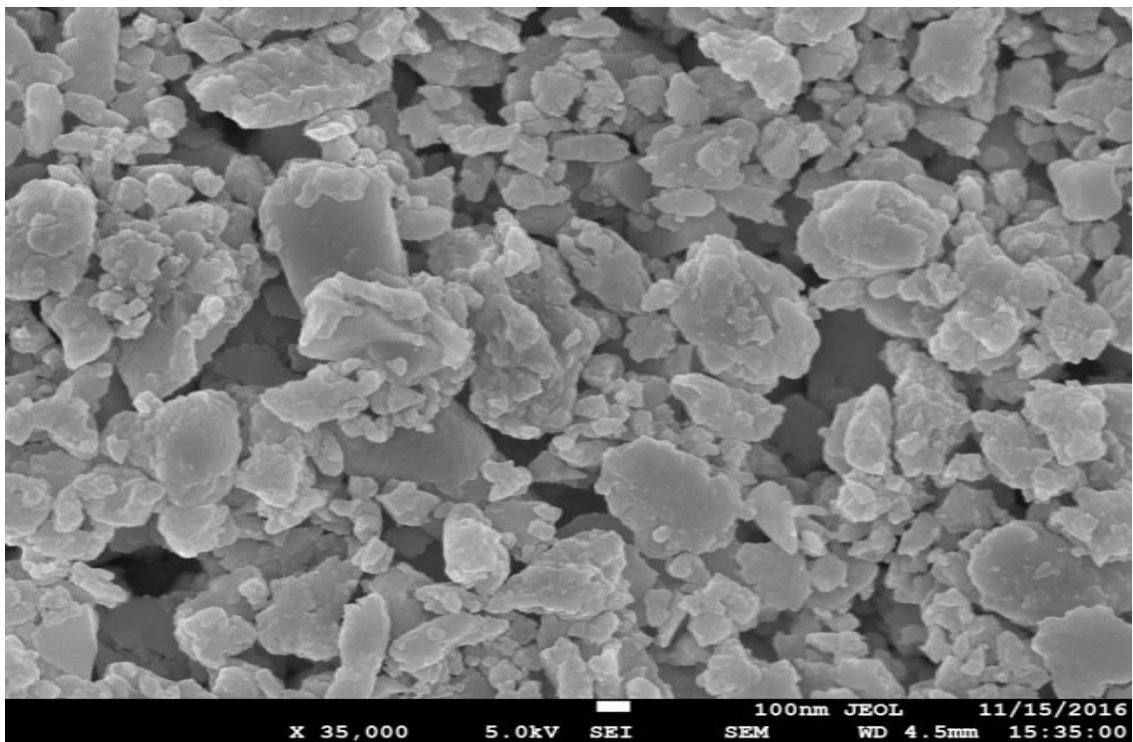


Fig 4(a). SEM image of nano RP (10 hr sample)

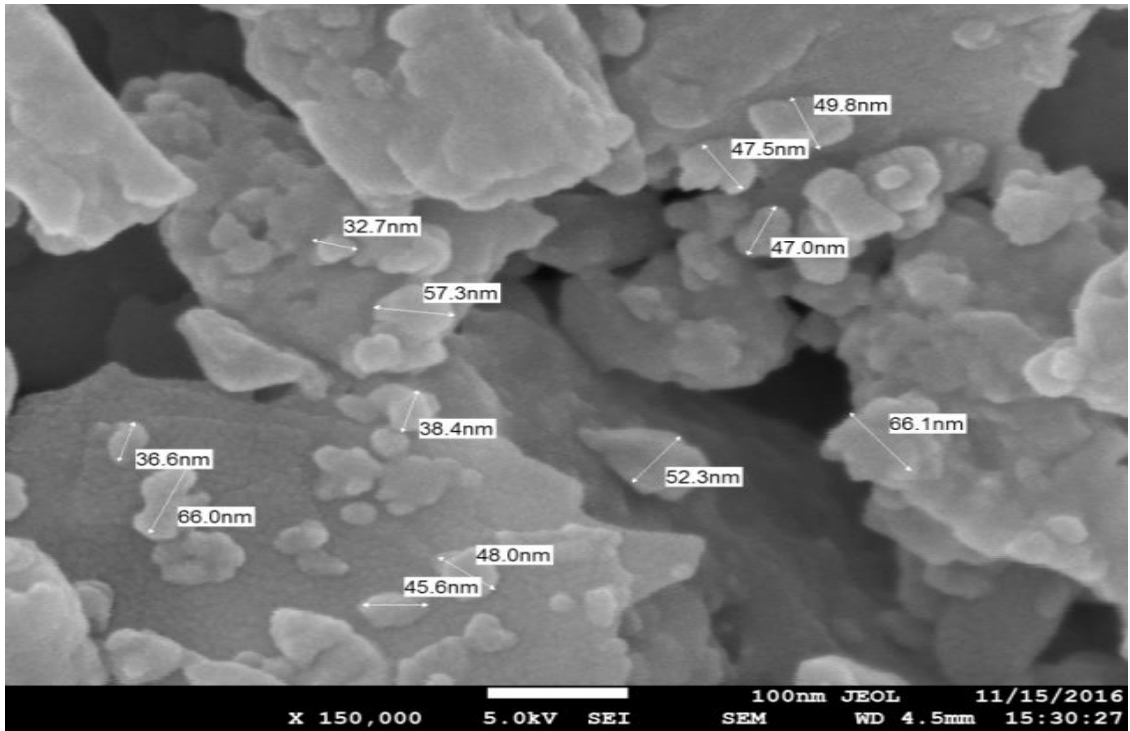


Fig 4(b). SEM image of nano RP (10 hr sample)

Soil Column Studies

Ortho-P loadings in Leachate Samples

Table5: Ortho-P (ppm) in leachate samples of different treatments

	Day0	Day2	day5	Day8	Day11	Day14
Control	0	0	0.01	0.04	0.02	0
SSP	0	0	0.007	0.013	0.207	0.057
Bulk RP	0	0	0	0.135	0.161	0.033
Nnao RP	0	0.02	0.183	0.38	0.337	0.27

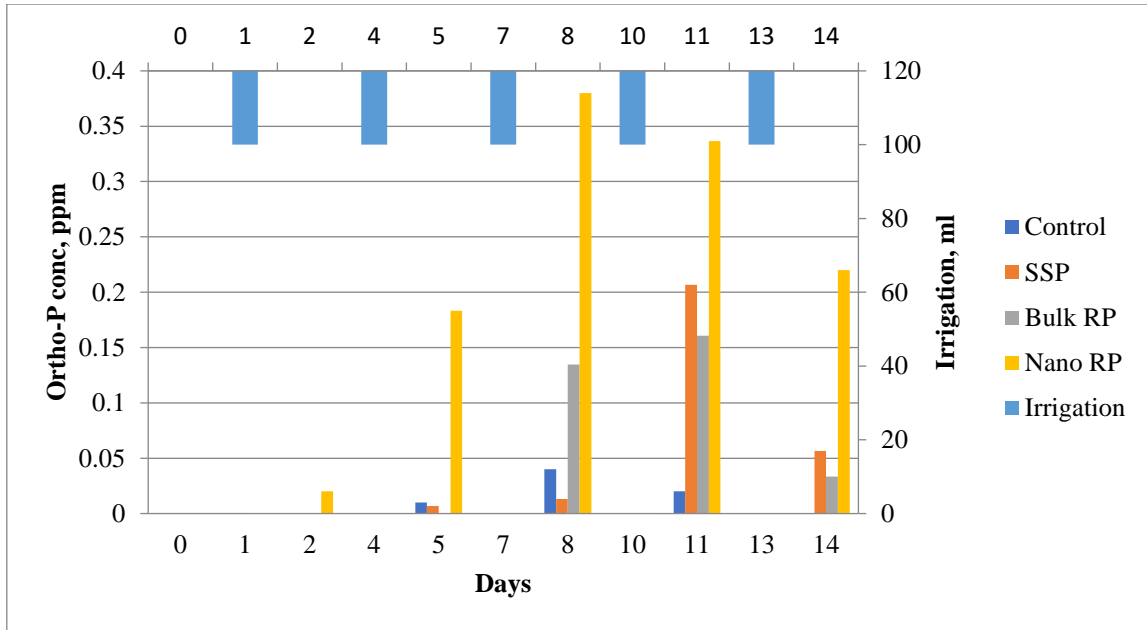


Fig5. Ortho P loadings in leachate samples

Total-P loadings in Leachate Samples

Table6: Total P loadings (ppm) in leachate samples

	Day0	Day2	Day5	Day8	Day11	Day14
control	37.26	49.74	36.55	52.04	41.84	38.88
SSP	43.24	49.75	37.4	40.4	45.67	46.78
Bulk RP	44.98	43.69	37.46	31.18	36.68	44.44
Nano RP	40.21	37.69	38.58	36.08	40.18	43.46

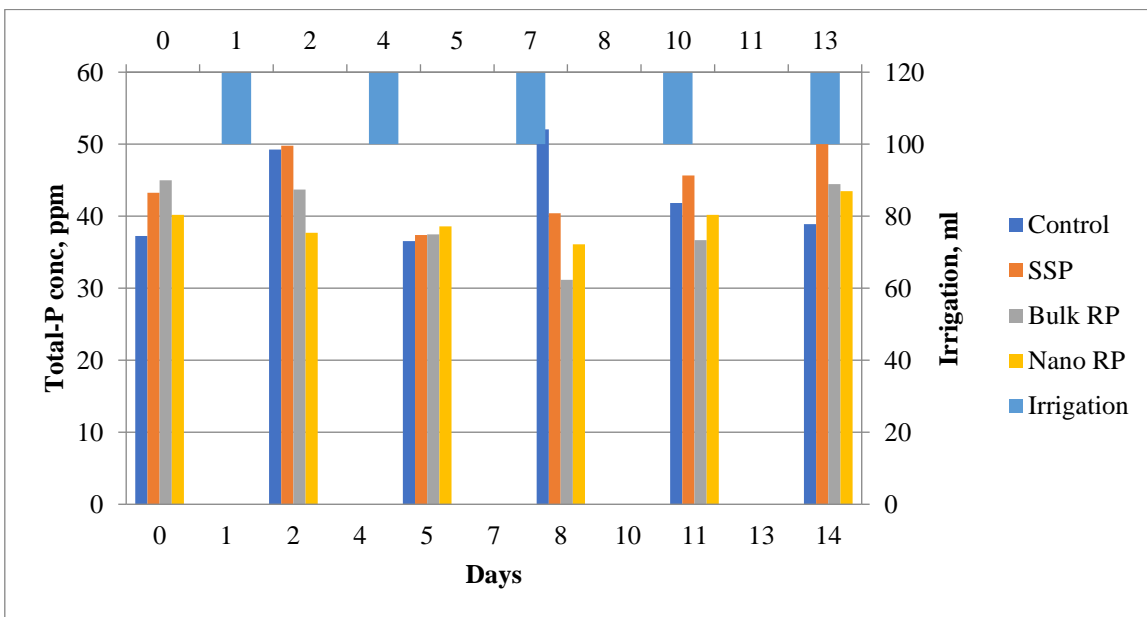


Fig6: Total P loadings in leachate samples.

Distribution of total p at three different depths in soil in different treatments.

Table6: Total P concentrations (ppm) at three different depths in different soil columns

Depth, cm	Control, ppm	SSP, ppm	Bulk RP, ppm	Nano RP, ppm
0-1	520.64	536.0767	507.7733	537.0633
9-10	506.65	509.4633	489.7567	516.7033
34-35	484.58	577.2333	501.5967	515.4867

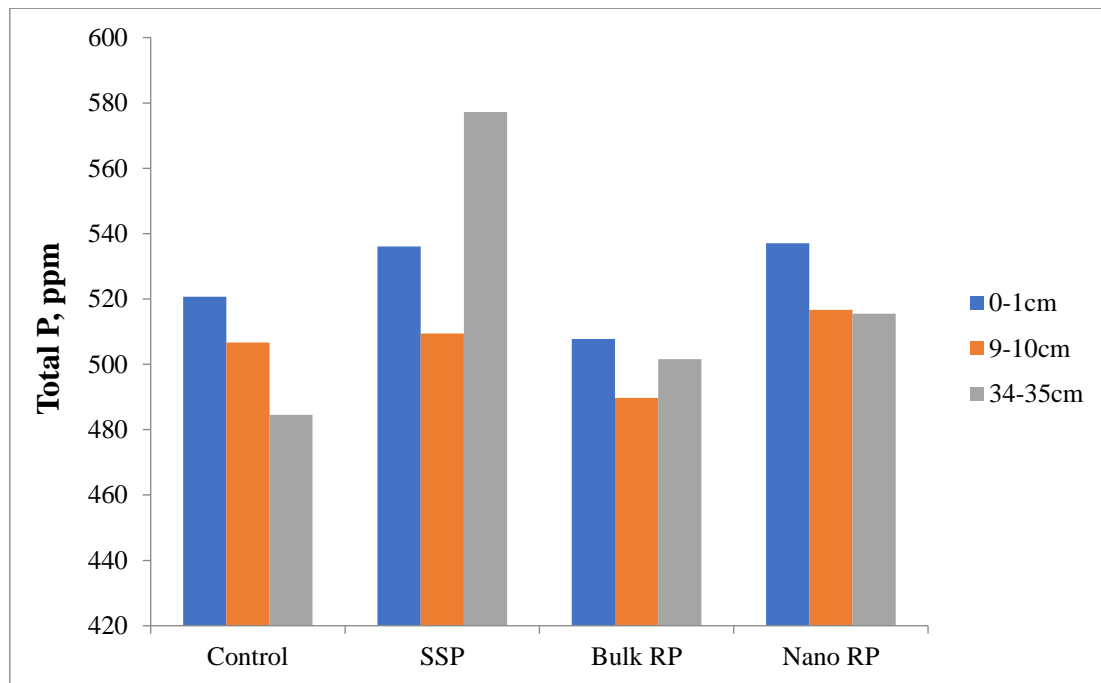


Fig7: Distribution of total p at three different depths in soil in different treatments.