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Effect of different inorganic phosphorus sources and organics on dynamics of p in typic haplustalf

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ABSTRACT

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A field experiment was conducted during Jan-April, 2007 in Typic Haplustalf soil to examine the effect of different sources of phosphorus and organics on dynamics of phosphorus under maize cultivation. The experimental field of the normal soil was sandy clay loam in texture which comprised of 74.01% sand, 4.35% silt and clay 21.30%. It was neutral in reaction (pH 7.3), non saline in nature with electrical conductivity of 0.21 dSm^{-1} and cation exchange capacity of 15.7 cmol (p+) kg^{-1}, less sodicity with exchangeable sodium percentage of 11.5, the exchangeable calcium, magnesium, sodium and potassium content of the soil were 5.2, 2.20, 1.8 and 6.3 cmol (p+) kg^{-1} respectively, low in organic carbon (0.21%), low in available N (201 kg ha^{-1}), low in available P (9.63 kg ha^{-1}) and high in available K (388 kg ha^{-1}). The treatments included here were Control, SSP alone, SSP + GM @ 10 t ha^{-1}, SSP + FYM @ 12.5 t ha^{-1}, SSP + VC @ 0.5 t ha^{-1}, DAP alone, DAP + GM @ 10 t ha^{-1}, DAP + FYM @ 12.5 t ha^{-1} and DAP + VC @ 0.5 t ha^{-1} The results of the experiment indicated that the application of SSP + GM @ 10 t ha^{-1} in saline soil recorded higher release of P from its fractions such as inorganic P, Olsen's P, and organic P. The mean values ranged from 219.24 kg ha^{-1} to 198.13 kg ha^{-1} of Ca-P, 233.29 to 227.13 kg ha^{-1} in Fe-P and 206.49 to 191.56 kg ha^{-1} in Al-P, 160.86 to 150.80 kg $ha^{-1}$of saloid bound P, 224.93 to 223.42 kg ha^{-1} of reductant soluble P, 25.81 to 12.01 kg ha^{-1} of Olsen's P were recorded.

Introduction

Phosphorus in one of the major elements for all plants. Its availability is very hardly of 20 % to the crop species. Among the major nutrients, phosphorus ranks next to nitrogen in importance on account of its vital role in major life processes. Its availability to the growing crop at required level is of prime importance in soil fertility. Phosphorus fertilization is imminent to all crops for maximizing crop yield. Selection of suitable P fertilizer based on soil type is very important. Application of fertilizer P in balanced proportion with other essential nutrients produces higher crop yields and ensures more profit to farmers. The importance of phosphorus in the maintenance of soil fertility and improving productivity is recognized now, as two-thirds of Indian soils are known to give

universal response to P application. It is the most critical element in highly weathered tropical and subtropical soils and per cent utilization of applied P by the crops is very low. Around 80 % of applied phosphorus is getting fixed in the soil due to its negativity electric charge on its surface. But there exists a dynamic equilibrium between the inorganic fractions, Olsen's fractions and organic fractions of phosphorus in soil. India has a vast scope for utilization of organic manures such as green manures, farmyard manure, vermicompost and other industrial by-products. Utilization of organic materials in conjunction with inorganic fertilizers leads to improved crop productivity in various soil conditions. Organic manures have considerable quantities of macro and micro nutrients, besides having ameliorating effects and can be used to improve the physical, chemical and biological properties of salt affected soils. On decomposition of organic manures, the release of organic and inorganic acids would have the capacity to increase the dissolution of phosphorus in soil and thereby hike the availability of phosphorus to the crop plants. Keeping these points in mind, the present investigation was taken up.

Materials and Methods

A field experiment was conducted during Jan-April, 2007 in saline soil to examine the effect of different sources of phosphorus and organics on dynamics of phosphorus under maize cultivation. The experimental field of the normal soil was sandy clay loam in texture which comprised of 74.01% sand, 4.35% silt and clay 21.30%. It was neutral in reaction (pH 7.3), non saline in nature with electrical conductivity of 0.21 dSm^{-1} and cation exchange capacity of 15.7 cmol (p+) kg^{-1}, less sodicity with exchangeable sodium percentage of 11.5, the exchangeable calcium, magnesium, sodium and potassium content of the soil were 5.2, 2.20, 1.8 and 6.3 cmol (p+) kg^{-1} respectively, low in organic carbon (0.21%), low in available N (201 kg ha^{-1}), low in available P (9.63 kg ha^{-1}) and high in available K (388 kg ha^{-1}). The treatments included here were Control, SSP alone, SSP + GM @ 10 t ha^{-1}, SSP + FYM @ 12.5 t ha^{-1}, SSP + VC @ 0.5 t ha^{-1}, DAP alone, DAP + GM @ 10 t ha^{-1}, DAP + FYM @ 12.5 t ha^{-1} and DAP + VC @ 0.5 t ha^{-1}. The treatments were replicated thrice in a randomized block design with the plot size of 5x4m. The test crop of maize cv. Ganga was grown upto maturity and harvested. The soil phosphorus fractions were estimated by the method described by Peterson and Corey (1966).

Results and Discussion

The results revealed that the concentration of Ca-P, reductant soluble P, Fe-P, Al-P, saloid bound P and Olsen's P was also getting reduced in soil with crop maturity (Table 1, 2 &3). The results of the experiment indicated that the application of SSP + GM @ 10 t ha^{-1} in soil recorded higher release of P from its fractions such as inorganic P, Olsen's P, and organic P. The mean values ranged from 219.24 kg ha^{-1} to 198.13 kg ha^{-1} of Ca-P, 233.29 to 227.13 kg ha^{-1} in Fe-P and 206.49 to 191.56 kg ha^{-1} in Al-P, 160.86 to 150.80 kg $ha^{-1}$of saloid bound P, 224.93 to 223.42 kg ha^{-1} of reductant soluble P, 25.81 to 12.01 kg ha^{-1} of Olsen's P were recorded. It might be due to the fact that the addition of green manures could increase the soil test P (Vanlauwe *et al.,* 2000) and decrease P sorption in normal and saline soils. Besides, the green manures convert relatively unavailable native and residual fertilizer P to more available form. Similar trend was also reported by Braum and Helmke (1995). The concentration of organic P was getting raised with advancement in crop growth in all the treatments applied (Table 4). The increase in the concentration of organic P was recorded in the treatment with the application of SSP combined with GM. It might be due to the

addition of high amount of organic matter by green manuring, which in turn released organic acids in huge amount and they have higher affinity to fix the phosphorus to a large extent. Similar trend was also reported by Amita Gharu and Tarafdar (2004).

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Table 1. Effect of different inorganic P sources and organics on Olsen's - P and Ca -P (kg ha^{-1}) concentration at different stages of crop growth

Treatments	Olsen's P							Ca -P						
	Days interval													
	15	30	45	60	75	90	105	15	30	45	60	75	90	105
T_1 - control	7.74	7.10	6.25	5.20	5.10	4.84	4.80	932.74	940.50	953.40	959.20	970.10	983.10	990.81
T_2 – SSP alone	18.56	16.54	13.33	11.65	11.01	10.74	10.02	953.11	968.14	973.21	986.14	992.51	1001.23	1011.81
T_3 – SSP + GM	24.21	21.33	17.66	14.25	13.11	12.25	11.11	996.54	990.33	982.14	976.39	972.54	970.06	965.11
T_4 – SSP + FYM	24.00	20.12	18.55	13.31	11.83	11.77	11.02	994.26	987.16	984.24	980.17	978.23	963.54	961.00
T_5 – SSP + VC	21.55	18.13	16.21	12.20	11.86	11.23	10.61	973.56	971.11	969.24	966.31	962.47	958.38	954.33
T_6 – DAP alone	13.26	11.33	10.15	9.27	8.91	8.55	8.17	898.24	900.03	902.18	906.53	908.17	910.54	913.56
T_7 – DAP + GM	14.23	12.56	10.55	10.23	10.10	9.84	9.70	943.55	940.14	938.20	937.02	935.33	931.11	930.03
T_8 – DAP + FYM	14.21	11.11	10.85	10.42	10.23	9.65	9.29	937.16	934.24	933.19	931.24	930.16	928.01	927.00
T_9 – DAP + VC	13.25	10.51	9.70	9.41	9.26	8.94	8.64	912.24	911.24	910.86	907.11	906.24	905.05	903.17

Table 2. Effect of different inorganic P sources and organics on Fe - P and Al -P (kg ha^{-1}) concentration at different stages of crop growth

Treatments	Fe- P							Al -P						
	Days interval													
	15	30	45	60	75	90	105	15	30	45	60	75	90	105
T_1 - control	80.42	81.10	81.73	82.20	82.90	83.10	83.24	93.20	92.31	91.40	90.70	90.11	89.30	88.60
T_2 – SSP alone	86.54	87.09	87.35	88.08	88.60	88.91	89.30	99.90	98.56	97.00	95.54	94.25	92.54	91.35
T_3 – SSP + GM	84.17	84.01	83.90	83.74	83.48	83.27	83.03	96.34	94.17	92.20	90.17	88.30	85.64	84.36
T_4 – SSP + FYM	85.36	85.04	84.84	84.49	84.12	83.78	83.24	97.58	95.34	92.18	90.24	89.16	88.41	86.23
T_5 – SSP + VC	86.10	86.00	85.94	85.73	85.54	85.31	85.13	98.15	96.20	94.14	92.27	91.05	90.13	89.11
T_6 – DAP alone	81.50	82.36	82.80	83.24	83.93	84.25	84.96	94.50	93.20	92.19	91.15	90.70	90.04	89.28
T_7 – DAP + GM	79.81	79.48	79.10	78.93	78.61	78.54	78.50	92.26	90.54	89.30	88.24	87.23	86.17	85.33
T_8 – DAP + FYM	80.23	80.11	79.97	79.74	79.59	79.20	79.10	92.51	91.16	90.13	89.54	88.13	87.39	86.15
T_9 – DAP + VC	81.13	81.02	80.97	80.65	80.41	80.30	80.24	93.01	92.25	91.36	90.18	89.59	88.36	87.50

Table 3. Effect of different inorganic P sources and organics on Saloid bound - P and Reductant soluble -P (kg ha^{-1}) concentration at different stages of crop growth

Treatments	Saloid bound P							Reductant soluble -P						
	Days interval													
	15	30	45	60	75	90	105	15	30	45	60	75	90	105
T_1 - control	282.44	280.70	279.40	279.20	278.80	278.25	278.00	79.91	79.80	79.76	79.76	79.70	79.70	79.68
T_2 – SSP alone	308.08	307.00	305.73	304.00	303.86	303.21	302.61	85.80	85.50	85.48	85.31	85.31	85.24	85.15
T_3 – SSP + GM	300.25	298.14	296.34	295.08	293.26	290.34	286.58	86.76	86.54	86.23	86.08	85.91	85.84	85.75
T_4 – SSP + FYM	302.13	300.82	298.81	296.34	295.00	294.12	291.50	86.21	86.20	86.01	85.94	85.88	85.75	85.71
T_5 – SSP + VC	304.51	303.36	301.54	300.17	298.16	297.00	295.66	86.00	85.81	85.58	85.39	85.11	85.00	84.93
T_6 – DAP alone	286.83	286.50	286.00	285.58	285.05	284.96	284.50	83.24	83.21	83.17	83.15	83.09	83.04	83.00
T_7 – DAP + GM	284.33	283.60	282.80	282.13	281.35	280.00	279.65	84.38	84.24	84.12	84.00	83.94	83.76	83.60
T_8 – DAP + FYM	285.14	284.85	284.06	283.51	283.15	282.46	281.37	84.20	84.10	83.98	83.71	83.56	83.30	83.19
T_9 – DAP + VC	286.00	285.64	285.10	284.89	284.30	283.90	283.22	83.85	83.79	83.64	83.51	83.48	83.36	83.24

Table 4. Effect of different inorganic P sources and organics on Organic - P (kg ha^{-1}) concentration at different stages of crop growth

Treatments	Days intervals						
	15	**30**	**45**	**60**	**75**	**90**	**105**
T_1 - control	516.00	514.20	508.10	503.12	497.20	478.05	468.40
T_2 – SSP alone	523.00	521.41	517.86	514.01	502.38	494.26	475.36
T_3 – SSP + GM	538.23	539.00	539.26	540.08	540.91	541.54	542.08
T_4 – SSP + FYM	534.19	535.22	536.14	536.88	538.20	539.63	540.56
T_5 – SSP + VC	530.12	530.66	531.29	532.00	532.85	533.96	535.17
T_6 – DAP alone	506.84	506.51	505.83	505.24	504.91	504.50	504.18
T_7 – DAP + GM	511.16	511.43	511.90	512.08	512.36	512.78	513.00
T_8 – DAP + FYM	509.83	510.24	510.71	511.16	511.56	511.70	511.86
T_9 – DAP + VC	507.24	507.38	507.73	508.20	508.54	508.78	509.10