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Research Article

EFFECT OF PHOSPHORUS MANAGEMENT ON SOIL PROPERTIESIRRIGATED WITH SODIC WATER

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Abstract- A pot experiment was conducted to asses the effect of phosphorus management in summer mungbean irrigated with sodic water during 2013. Three levels each of sodic water (control, 3.0 and 6.0 mmol/L), and phosphorus (control, 15 and 30 mg/kg of soil, were tested in complete randomized design with three replications. The results indicated that application of irrigation water having RSC 1.0 mmol/L and phosphorus 30 mg/kg of soil recorded the maximum and significantly higher total and available phosphorus, dehydrogenase enzyme activity and alkaline phosphorus activity over rest of the treatments. However, pH, EC and ESP did not show any significantly difference under different levels of phosphorus.

Keywords- Mungbean, Phosphorus and RSC

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Introduction

In many arid and semi-arid regions, use of saline and sodic water for irrigation in the absence of appropriate soil-water-crop management practices, often leads to the builds-up of salinity and sodicity in the soil profile which adversely affect the crop productivity and soil productivity. The use of sodic water for irrigation adversely affects productivity of soil by influencing the uptake of nutrients and many soil properties. Such waters usually have sodium carbonate as a predominant salt [1]. The prolonged use of such water immobilizes soluble calcium and magnesium in the soil by precipitating them as carbonates consequently the concentration of sodium in the soil solution and exchangeable complex increases and leads to the development of sodic conditions. The increased exchangeable sodium percentage (ESP) and pH of soil resulting from the long term use of sodic water leads to break down of soil structure due to swelling and dispersion of clay particles.

Responses of crops to P application on sodic soils have been reported by several workers Tomar*et al.* 1996 and Yadav *et al.* 2009 and it has been suggested that plants grown on saline and sodic soils may have higher P requirements than normal soils because the work against the osmotic force on absorption, translocation and accumulation of inorganic ions may be accomplished at the expense of phosphate energy, phosphorilated intermediates could act as carrier or trapping agents of anions and cations and inorganic phosphates are components of buffer system of plants Pattanayak *et al.* 2009[2-4].

Review of literature

Chesti and Ali (2012) reported that application of 30 kg P_2O_5 ha^{-1} recorded significantly higher microbial population in rhizosphere as compared to 60 kg P_2O_5 ha^{-1}[5].

Kumawat and Yadav (2013) reported that with increasing levels of RSC in irrigation water from 2.5 to 7.5 mmol L^{-1}, the ECe, of soil decreased significantly while, pH and ESP of soil increased significantly [6].

Material and Methods

A pot experiment was conducted in Cage House of Department of Plant Physiology, S.K. N. College of Agriculture, Jobner during 2013 in a Complete Randomized design (CRD) with three replications .The soil was loamy sand in texture, alkaline in reaction (pH 8.10), organic carbon (1.85g/kg), low in nitrogen (128 kg/ha), medium in available phosphorus (20 kg P_2O_5/ha) and potassium (146 kg K_2O/ha) content. Bulk density, particle density, Na, Ca, Mg, CEC, exchangeable Na and ESP (1.50 Mg m-3, 2.60 Mg m-3, 9.60 me/L, 1.2 me/L, 6.8 cmol (P^+) kg/soil, 0.65 cmol/kg and 9.55, respectively) of experimental soil. The different RSC water was prepared artificially by dissolving required amount of $NaHCO_3$, NaCl, Na_2SO_4, $CaCl_2$ and $MgCl_2$ in base water (control). The tap water was used for first irrigation in all the pots and later on crop was irrigated 6 times with water of varying RSC during experimentation as per treatment and also three levels of phosphorus (control, 15 and 30 mg/kg of soil).

Results and Discussion

The results that indicated application of irrigation water with RSC 6.0 mmol/L significantly increased the soil pH, EC and ESP in mungbean as compared to other treatments. Application of RSC water @ 6 mmol/L recorded the maximum pH, EC and ESP over the other treatments [Table-1]. Increase in pH, EC nd ESP of soil due to use of irrigation water with higher RSC for irrigation is attributed to increase sodicity and decreased of ca in irrigation water because of precipitation of Ca and Mg as carbonates providing more opportunity for Na to be absorbed on the exchange complex [7,8]. Application of low RSC irrigation water (1.0 mmol/L) showed significantly higher total phosphorus, available phosphorus, dehydrogenase enzyme activity and alkaline phosphate activity over rest of the treatments. Divalent cations enhanced p adsorption relative to monovalent cations, hence soil saturated with Na^+ retained less amount of P than Those saturated with Ca^{2+} ions Tisdle et al., 1995[9].

Effect of Phosphorus: The application of phosphorus @ 30 kg/ ha significantly increased total phosphorus, available phosphorus, dehydrogenase enzyme activity and alkaline phosphate activity over rest of treatments [Table-2 and 3]. Increased microbial and root activity in the rhizosphere may generally accounts for higher phosphatase [10,11]. However, pH, EC and ESP did not show significantal differences under different level of phosphorus.

Table-1 *Effect of different RSC water and phosphorus on pH, ECe and ESP*

Treatments	pH	ECe (dSm^{-1})	ESP
RSC water			
S_0	8.00	2.89	17.21
S_3	8.22	2.67	18.83
S_6	8.41	2.45	20.45
SEm$\pm$	0.03	0.01	0.08
CD (P=0.05)	0.07	0.03	0.24
P level (mg P kg^{-1} soil)			
P_0	8.25	2.65	18.99
P_{15}	8.21	2.67	18.85
P_{30}	8.17	2.69	18.65
SEm$\pm$	0.03	0.01	0.08
CD (P=0.05)	NS	NS	NS

NS = Non-significant

Table-2 *Effect of different RSC water and phosphorus on total and available phosphorus in soil*

Treatments	Total P (%)	Available P (kg ha^{-1})
RSC water		
S_0	0.032	9.59
S_3	0.028	9.36
S_6	0.025	9.03
SEm$\pm$	0.001	0.04
CD (P=0.05)	0.003	0.12
P level (mg P kg^{-1} soil)		
P_0	0.025	8.96
P_{15}	0.029	9.37
P_{30}	0.031	9.65
SEm$\pm$	0.001	0.04
CD (P=0.05)	0.003	0.12

Table-3 *Effect of different RSC water and phosphorus on soil dehydrogenase enzyme activity and alkaline phosphatase activity*

Treatments	Dehydrogenase enzyme activity (p kat kg^{-1} soil)	Alkaline phosphatase activity (µ ml PNP produced g^{-1} h^{-1})
RSC water		
S_0	6.00	10.22
S_3	5.81	9.50
S_6	5.62	8.72
SEm$\pm$	0.06	0.04
CD (P=0.05)	0.18	0.12
P level (mg P kg^{-1} soil)		
P_0	5.60	8.77
P_{15}	5.80	9.40
P_{30}	6.03	10.27
SEm$\pm$	0.06	0.04
CD (P=0.05)	0.18	0.12

Table-4 *Effect of different RSC water and phosphorus on microbial biomass (P µg g^{-1} soil) at different growth stages*

Treatments	Months after sowing		After harvest
	I	II	
RSC water			
S_0	28.81	25.94	21.82
S_3	26.37	23.69	19.53
S_6	22.42	20.80	16.71
SEm$\pm$	0.06	0.06	0.06
CD (P=0.05)	0.18	0.18	0.19
P level(mg P kg^{-1} soil)			
P_0	22.41	20.98	16.85
P_{15}	26.25	23.52	19.31
P_{30}	28.94	25.93	21.90
SEm$\pm$	0.06	0.06	0.06
CD (P=0.05)	0.18	0.18	0.19

Summary and Conclusion

On the basis of one year experimentation, it seems quite logical to conclude that all the soil properties except pH and ESP, adversely affected with increasing RSC of irrigation water and significantly increased with increasing with level of phosphorus.

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Conflict of Interest: None declared

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