EFFECT OF SODIC SOILS ON CONCENTRATION OF SOME NUTRIENTS IN RICE PLANT

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Abstract:
This paper deals with chemical changes in some nutrients in rice plant under sodic soil. In this paper it is described that the sodic soils are low in several nutrients like available N,P,K,S,Zn,Mn and carbon. The present experiment reveals that the balanced fertilizer use increases the concentration of nutrients in rice plant under sodic soils.

INTRODUCTION

Some elements are essential for plant to growth, development and production. The plants cannot complete their normal life without any of the essential elements. The essential elements are C, O, H, N, P, Ca, Mg, S, Fe, Mn, Zn, Cu, B, Mo and Cl. Out of these C, O and H are needed in highest amounts and their source is atmosphere C and O comes from atmospheric CO_2 and H comes from H_2O Rest are mineral elements and all of them are taken up by the plants from soil. Out of these N is the most limiting mineral elements in the world soil. N is essential for all living organism. N is constituent of protein and a number of non-protein natural products like hormones, glycosides and chlorophylls in green plants. N carries genetic information i.e DNA and RNA are nitrogen compounds (Tisdale et al 1993). Phosphorus is the second most macronutrient required by all plants for growth and development. Many important biochemicals in plants contain phosphorus and phospholipids which are primary structural component of membranes that surrounded each plant cell and cell organelles.

DNA and RNA contain P as an integral component. These genetic informational molecules guide the synthesis of proteins. Much of the metabolism inside the cell is controlled by phosphorylation and dephosphorylation of certain proteins i.e. enzymes. The source of phosphate for signal events is ATP, which also serves as the major energy currency in the cell. (Blevin 1999)

Potassium is not a constituent of any organic compound in the plant its concentration is quite high some time more than nitrogen. K is involved in osmotic regulation in plant roots. The plants that are deficient in K suffer from water stress. Potassium is essential for photosynthesis, the plants also require K for producing ATP for CO_2 assimilation, formation and transport of sugars. (Tisdale et al 1985)

Sulphur has vital metabolic function in plants; it is required for synthesis in the form of sulphur containing amino acids like cystine, cystein, methionine, adenosyl methionine, and formyl methionine, which are essential components of proteins. Sulphur is also needed for synthesis of other metabolites including co-enzyme, biotin, thiamin, glutathione, S-adenosyl methionine, formyl methionine lipoic acid, sulpholipid and ferredoxin. Sulphur provides resistance for several diseases, improves quality and production of crops (Mengel and Kirkby 1987)

Zinc is most important cationic micronutrient and its deficiency is of wide occurrence in Indian Soils, Zinc promotes the formation of hormones, starch and sucrose (Nicholas 1961).

Manganese is a micronutrient which involved in the evolution of O_2 as a result of photolysis of H_2O in photosynthesis. It also takes part in oxidation reduction processes and in decarboxylation and hydrolysis reactions. Mn is needed for activation of many enzymes in citric acid cycle. (Romheld and Marscher 1992).

The plant normally absorb the simplest form of the above nutrients, however, profound chemical changes take place in the soil and plants. Keeping the above views and facts the present experiments were conducted on recently reclaimed sodic soils for paddy crop.

MATERIAL AND METHODS

An adaptive trial on farmer's field of faizabad district was conducted during the year 2009-2010 and 2010-2011 on fixed layout. The experiment was conducted on recently reclaimed sodic soils. The rice variety Ushar-1 was taken for study.

Soil analysis was done by international pipette method as described by piper (1966). pH and Ec of soil was analysed by the method given by Jakson (1967). Available N was determined by alkaline permanganate method (Subbiah and Asija 1956). Organic carbon was determined by weekly and black's rapid titration method (Olsen et al 1977) and available K was determined by flame photometric method (Jackson 1967). Available sulphur was determined by turbidimetric method (Chesnin and Yien 1950)

Availavle Zn and Mn was measured by atomic absorption spectrophotometer after preparation of DTPA (Diethylene Triamine penta Acetic acid) extract (Lindsay and Norvell 1978)

The plant grain and straw samples were processed for chemical analysis. The straw samples were first dried in air and then in an oven at 70c for eight hours, grounded in a Wiley mill and stored in a clean polythene bags. Similarly dried grain samples were processed. P was determined by vanadamolybdeat yellow colour method.(Chapman and pratt 1961). P was determined in triacid extract by flame photometer, Zn and Mn was determined by atomic absorption spectrophotometer.

RESULTS AND DISCUSSION

The nitrogen content of rice grain (table.1) varied from 1.32% to 1.44% during the first year and 1.37% to 1.47% during the second year. In straw (table.2) it varied from 0.21% to 0.26% and 0.21% to 0.25% in the first and second year respectively. The results were significant for both grain and straw. In case of grain nitrogen concentration appeared to increase with the addition of other nutrients significantly and NPKS+Zn+Mn gave the highest value in grain and straw both. Thus appeared that addition of nutrients in sequence increased with nutrient content.Similar results has been reported by Armstrong (1999), Tiwari and Gupta (2006)

The phosphorus content of grain varied 0.30% to 0.37% and 0.30% to 0.38% in first and second year respectively. The phosphorus content of straw varied 0.15% to 0.22% and 0.17% to 0.21% in first and second year respectively. The maximum phosphorus content was observed in the treatment NPKS+Zn+Mn during both the years, indicating that balanced use of nutrient increase the concentration of phosphorus in grain and straw both. The trends of variation in phosphorus concentration of straw were similar to that of grain and with the sequential addition and each nutrient gave significant increase in phosphorus concentration. Our results are similar with several other workers.(Yadav et al 2002 and Brady 2007)

The concentration of potassium in rice grain showed a range of variation from 0.24% to 0.34% and 0.25% to 0.34% during the first and second year respectively. The concentration of K in straw varied from 1.21% to 1.28% and 1.22 to 1.29% during the first and second year respectively. There was a small but significant difference in the potassium content of grain and straw. Addition of different nutrients including potassium increased the potassium content of grain and straw with each sequential addition of nutrients. Unlike other nutrients potassium concentration was much higher in straw than in grain (about six times). Our results fall in the line of results reported by Pathak (2009)

Sulphur content in grain varied from 0.20% to 0.26% and 0.21% to 0.27% in first and second year , respectively, Sulphur content in straw varied from 0.10% to 0.12% and 0.10% to 0.13% during the first and second year, respectively. Addition of nutrients increased the sulphur content significantly and treatment NPKS+Zn+Mn gave the maximum sulphur concentration. Several workers have described the role of sulphur in terms of yield response of crop. (Tiwari and Gupta 2006 , Millar 2007)

In all the above cases it is clear that the treatment NPKS+Zn+Mn gave maximum concentration of nutrients in grain and straw both.

The grain yield (Table.3) varied from 20.20 to 36.36 Qha^{-1} during the first and 19.90 to 37.30 Qha^{-1} during the second year, respectively and the results were significant for each sequential addition of nutrients. The straw yield varied from 27.81 to 51.24 Qha^{-1} and 26.80 to 53.30 Qha^{-1} during the first and second year, respectively. Addition of each elements resulted in significant increase in yield over the treatment without that element. The responses of added nutrients were high and it appeared justified to add the essential dements in sequence. Similar results have been reported by several other workers. (Singh et al 2004 and Dabermanne et al 2004)

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Table 1: Concentration of different nutrients in rice grain

Treatments	N%		P%		K%		S%	
	I^st^ Year	II^nd^ Year	I^st^ Year	II^nd^ Year	I^st^ Year	II^nd^ Year	I^st^ Year	II^nd^ Year
Control	1.32	1.37	0.30	0.30	0.24	0.25	0.20	0.21
N	1.33	1.37	0.31	0.31	0.26	0.26	0.21	0.22
NP	1.34	1.39	0.32	0.32	0.26	0.27	0.22	0.23
NPK	1.35	1.42	0.32	0.33	0.29	0.29	0.23	0.24
NPK+S	1.38	1.42	0.33	0.34	0.30	0.30	0.24	0.25
NPK+ Zn	1.39	1.42	0.34	0.34	0.29	0.29	0.24	0.25
NPK+ Mn	1.40	1.42	0.35	0.34	0.30	0.31	0.24	0.25
NPKS+ Zn	1.40	1.44	0.36	0.36	0.32	0.32	0.25	0.26
NPKS+ Mn	1.43	1.46	0.36	0.37	0.32	0.33	0.25	0.26
NPKS+ Zn+Mn	1.44	1.47	0.37	0.38	0.34	0.34	0.26	0.27
SE(Diff)	0.005	0.005	0.006	0.005	0.004	0.005	0.006	0.007
CD at 5%	0.011	0.011	0.010	0.010	0.009	0.010	0.013	0.015

Table 2: Concentration of different nutrients in rice straw

Treatments	N (%)		P (%)		K (%)		S (%)	
	I^st^ Year	II^nd^ Year	I^st^ Year	II^nd^ Year	I^st^ Year	II^nd^ Year	I^st^ Year	II^nd^ Year
Control	0.21	0.21	0.15	0.17	1.21	1.22	0.10	0.10
N	0.21	0.21	0.16	0.17	1.22	1.23	0.10	0.10
NP	0.22	0.21	0.17	0.18	1.24	1.26	0.11	0.11
NPK	0.23	0.21	0.19	0.18	1.24	1.26	0.11	0.12
NPK+S	0.23	0.23	0.20	0.19	1.26	1.25	0.1	0.11
NPK+Zn	0.23	0.23	0.20	0.19	1.25	1.26	0.11	0.12
NPK+Mn	0.24	0.24	0.19	0.19	1.25	1.28	0.10	0.12
NPKS +Zn	0.25	0.25	0.21	0.20	1.27	1.28	0.11	0.12
NPKS+Mn	0.26	0.25	0.21	0.20	1.28	1.29	0.12	0.13
NPKS+Zn+Mn	0.26	0.25	0.22	0.21	1.28	1.29	0.12	0.13
SE(Diff)	0.006	0.005	0.007	0.007	0.008	0.007	0.002	0.0017
CD at 5%	0.012	0.010	0.014	0.013	0.017	0.015	0.004	0.0035

Table 3: Effect of different treatments on grain and dry matter yield of rice (Q ha^{-1})

Treatments	I^st^ Year		II^nd^ Year	
	Grain Yield	Straw Yield	Grain Yield	Straw Yield
Control	20.20	27.81	19.90	26.80
N	24.28	32.69	24.51	33.90
NP	27.08	36.81	27.21	37.97
NPK	29.00	40.89	29.52	41.77
NPK+S	31.50	42.70	31.86	44.69
NPK+ Zn	31.44	42.65	31.61	44.67
NPK+ Mn	30.50	41.40	30.84	43.44
NPKS+ Zn	35.00	48.19	35.89	50.00
NPKS+ Mn	34.00	49.17	36.70	51.40
NPKS+ Zn+Mn	36.36	51.24	37.30	53.30
SE(Diff)	0.265	0.368	0.368	0.378
CD at 5%	0.541	0.760	0.756	0.775