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EFFECT OF SOME NUTRIENTS IN RICE PLANT UNDER SODIC SOILS

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Abstract

A field experiment was conducted on farmer's field of Faizabad district during the period 2010 and 2011. The nutrients were applied on soil test recommendation basis with three replications under randomize block design. The soil was low in organic carbon, available nitrogen, P_2O_5, sulphur, zinc, manganese; available potassium (K_2O) was medium in category. pH and EC of soil was 9.0 and 0.29 dSm^{-1} respectively. The yield of grain varied from 20.20 to 36.36 and 19.90 to 37.30 Qha^{-1} during both the years, respectively. The straw yield varied from 27.81 to 51.24 and 26.80 to 53.30 Qha^{-1} during both the years, respectively. The concentration of N, P, K, S, Zn and Mn increases with increasing doses of fertilizers. The uptake value of above mentioned nutrients were calculated on the basis of biological yield and concentration of nutrients. The soil of experimental field was found deficient in almost all the nutrients tested under missing nutrient technique. The satisfactory yield could be obtained with the addition of N, P, K, S, Zn and Mn on soil test recommendation basis.

Introduction

All the elements play very important role in plant metabolism plants can not complete their normal life cycle, if any of the essential elements is missing. These elements are carbon, oxygen, hydrogen, nitrogen, phosphorus, calcium, magnesium, sulphur, iron, manganese, zinc, copper, boron, molybdenum and chlorine. Out of these, carbon, oxygen and hydrogen are needed in highest amount and their source is atmosphere. In current study the N, P, K, S, Zn and Mn have been taken under missing nutrient technique on site specific basis on rice crop. Salt affected lands occupy an area of more than 1000 mha on global basis. Besides serious decline in the yield due to salinization and sodification. Out of 7.4 mha salt affected lands in the country, 1.15 mha was found in U.P. alone (Pathak 2009).

Growing of sodicity tolerant crops/varieties has been found to be successful in post reclamation management. The N is the most limiting nutrient in the world soil. Nitrogen is constituent of a number of non protein natural products like hormones, glycosides and chlorophyll in green plants. They are also related to carbohydrate utilization in plants, nitrogen is taken up by the plants in the form of nitrate (NO_3^{-1}) and ammonium (NH_4^+) ion from the soil (Tisale et al., 1993).

Phosphorus is the second most important macronutrients required by all plants for growth developments and production. Water movement through xylem is regulated by phosphate. The system is very responsive to phosphorus and increase with high level of phosphorus. Phosphorus is remobilized in seed and store genetic information in RNA and DNA. Phosphorus is taken by the plant in the form of $H_2PO_4^{-1}$, HPO_4^{-2} and PO_4^{-3} ions (Blevin 1999).

Potassium is essential for photosynthesis, malfunctioning of stomata due to potassium deficiency lowers the rate of photosynthesis and water utilisation, potassium reduces the water loss due to transpiration. The potassium concentration in plant tissues ranges from 1-4%, potassium is taken by the plants as K^+ ion. Potassium imparts resistance to plant from lodging and a number of diseases and pests (Tisdale et al., 1993).

Sulphur has vital metabolic function in plants; it is required for synthesis in the form of sulphur containing aminoacids like cystine, methionine, adenosyl methionine and formyl methionine, which are essential components of proteins. Sulphur is absorbed in plants in the form of sulphate (SO_4^{-2}) ion. Bulk of sulphur in soils is organically bound. Plant foliage contains sulphur between 0.1 to 0.4% and seeds contain 0.18% to 1.7% sulphur (Mengel and Kirkby 1987). Zinc is most important cataionic micronutrient and its deficiency is wide occurrence in Indian soil. It is absorbed by plants in the form of zinc ion (Zn^{+2}), zinc promotes the formation of hormones, starch and sucrose. (Nicholas 1961). Manganese is a micronutrient whose normal concentration in plants ranges from 20-500 ppm. Below 20 ppm concentration the plants are considered manganese deficient, manganese is absorbed by the plants as Mn^{+2} ions. Manganese is needed for activation of many enzymes in citric acid cycle (Romheld and Marscher, 1992). Keeping the above view 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 was conducted at village Chitawna of Faizabad district during two consecutive seasons 2009-2010 and 2010-2011, on fixed lay out. The experiment was conducted on recently reclaimed sodic soils with three replications, RBD design and rice variety Ushar-1 was taken for study.

Soil analysis

The mechanic separates was done by international pipette method as described by Piper (1966). The important physico-chemical characteristics of soil are presented in Table 1.

pH and EC

pH and EC of soil was analyzed by the method given by (Jackson 1967).

Available nitrogen

Available nitrogen was determined by alkaline permanganate method (Subbiah and Asija 1956).

Organic carbon

Organic carbon was determined by Walkley and Black's rapid titration method (Jackson 1967) and available P by Olsen method (Olsen et al., 1977). Available Potassium was determined by flame photometric method (Jackson 1967). Available sulphur was determined by turbidimetric method (Chesnin and Yien, 1950). Available zinc and manganese was measured by atomic absorption spectrophotometer after preparation on of DTPA (Diethylene Triamine Penta Acetic Acid) extract (Lindsay and Norvell, 1978).

Plant analysis

The plant, grain and straw samples were processed for chemical analysis. The straw samples were first dried in air, then in an oven at 70^0C for eight hours, ground in a Wiley mill having all stainless parts and stored in a clean polythene bags. Similarly, dried grain samples were also crushed and ground. Nitrogen was determined by Kjeldohl's method (Jackson 1967). Phosphorus was determined by vandamolybdeate yellow colour method. (Chapman and Pratt 1961). Potassium was determined in triacid extract by flame photometer zinc and manganese was determined by atomic absorption spectrophotometer.

Result and Discussion

The results obtained in the study are discussed as under:

Grain and straw yield

The grain yield varied from 20.20 to 36.36 Qha^{-1} during the first year and 19.90 to 37.30 Qha^{-1} during the second year and the results were significant for each sequential addition of nutrients. The straw yield varied from 27.81 to 51.24 and 26.80 to 53.30 Qha^{-1} during the first and second year, respectively (Table 2).

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 elements in sequence. The total dry matter varied from 48.01 to 87.60 and 46.70 to 90.60 Qha^{-1} for the first and second year, respectively.

Responses of the nutrients on rice yield

The data clearly indicated that addition of nitrogen alone was responsible for 18.88% and 24.83% increase in dry matter yield during the first and second years respectively. Response of phosphorus was 12.07% and 11.52% in dry matter yield during the first and second year respectively. Potassium responses were 7.87% and 9.25% in dry matter yield during both the years. Responses of sulphur in dry matter yield were 8.00% and 7.47% during the first and second year respectively. Zinc responsible for 7.83% and 7.01% increase in dry matter yield during the first and second year respectively. Manganese responsible for 4.64% and 4.24% increase in dry matter yield in first and second year respectively. The commutative responses of the nutrients in dry matter yield were 82.13% and 93.16% during the first and second year respectively. The data indicating that responses of nutrients to grain and straw were almost similar however, the cumulative responses of the nutrients over control were much higher. Responses of nitrogen were the highest and those of manganese were the lowest.

As the soils were sodic and deficient in all the nutrients under investigation, the responses of nutrients were expectacular. The responses of different nutrients on percent mean basis were in N>P>S>K>Zn>Mn order during the first year and in N>P>K>S>Zn>Mn during the second year (Table 2).

The sodic soil when subjected to reclamation are impoverished of plant nutrients and offer reclamation the soil becomes low in most of the essential; elements due to salt removal and ionic displacement. Similar situation has been reported by Tandon and Kimmo (1993). Dobermann et al. (2004) reported that in saline sodic soil the nutrients must be supplied on the basis of soil testing in site specific nutrient management practices. Swaroop (1985a) reported that the alkali soils are highly deficient in organic matter and deficient in all essential plant nutrients Singh, et al, (2004) reported that rice and wheat are suitable crop under reclaimed sodic soils, Sharma et al (1982), reported that sodic soils are prone to micronutrient deficiencies particularly the zinc. Takkar and Nayyar (1981) reported that alkali soils are deficient in manganese.

Table 1: Important characteristics of soils of experimental field

S.No	Mechanical Separates	Ist Year	IInd Year
i.	Sand (%)	52%	50%
ii.	Silt (%)	17%	19%
iii.	Clay (%)	25%	26%
iv.	Textural Class	Sandy Loam	Sandy Loam

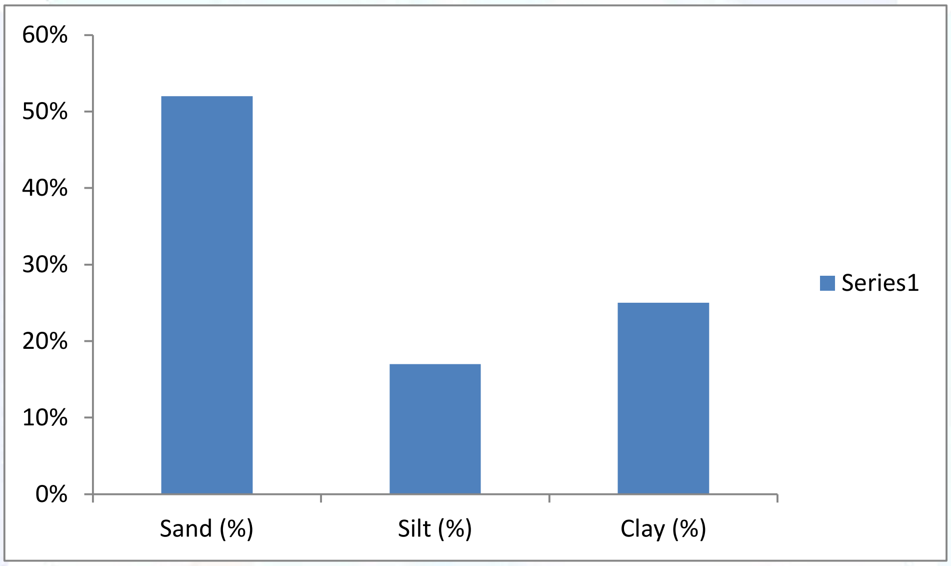

Figure.1 Important characteristics of soils of experimental field for Ist Year

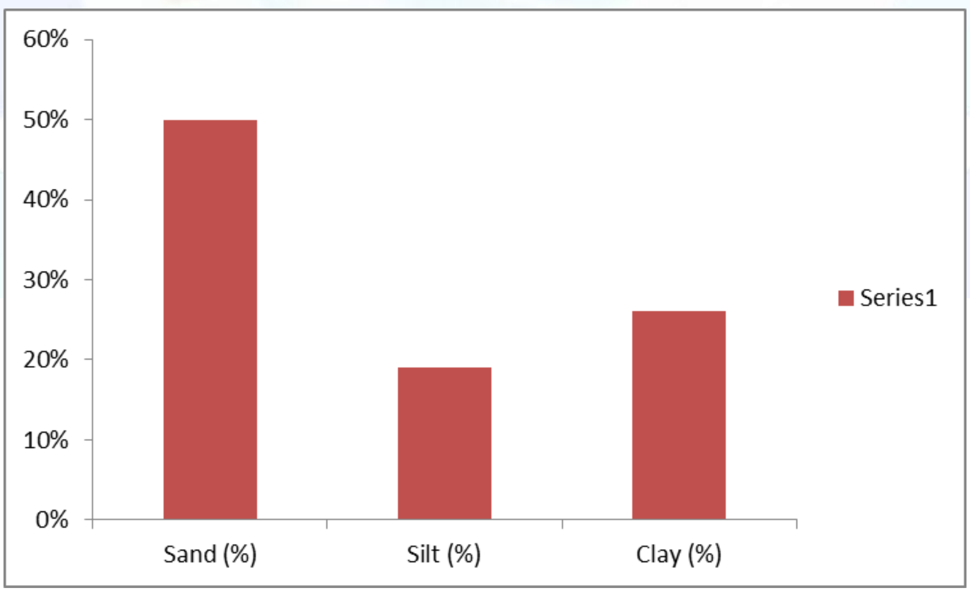

Figure.2 Important characteristics of soils of experimental field for Ist Year

Table 2: Effect of different treatments on grain and dry matter yield of rice (Q ha^{-1})

Treatments	Ist Year		IInd 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

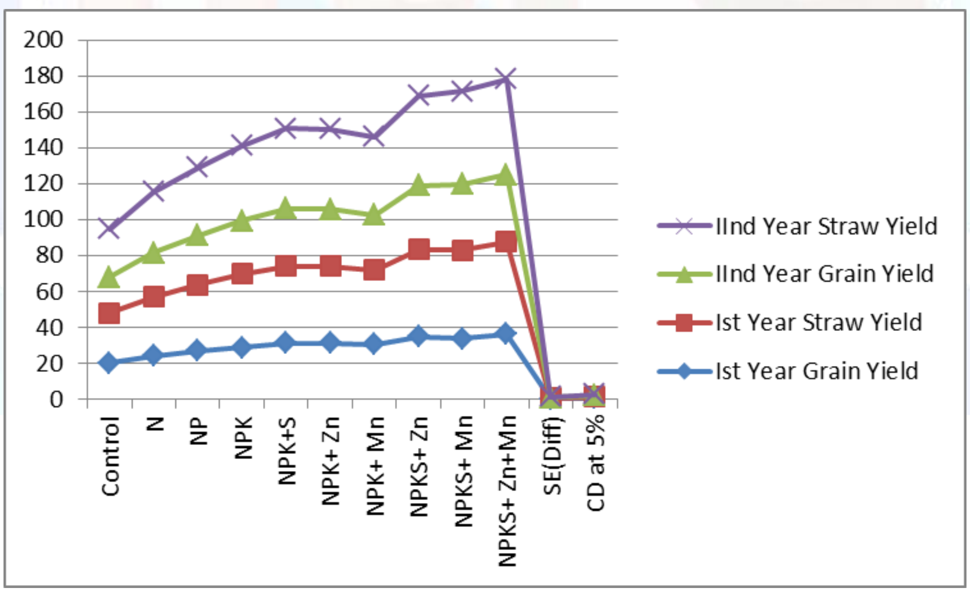

Figure.3 Graph for **:** Effect of different treatments on grain and dry matter yield of rice (Q ha^{-1})

Table 3: Portioning of responses of individual nutrients (%)

Portioning	Response of I[st] Year			Response of II[nd] Year		
	Grain	Straw	Average	Grain	Straw	Average
Percent response of N	20.20	17.55	18.88	23.17	26.49	24.83
Percent response of P	11.53	12.60	12.07	11.02	12.01	11.52
Percent response of K	7.79	8.08	7.87	8.49	10.00	9.25
Percent response of S	8.62	7.37	8.00	7.93	7.00	7.47
Percent response of Zn	8.41	7.24	7.83	7.08	6.94	7.01
Percent response of Mn	5.17	4.10	4.64	4.47	4.00	4.24
Cumulative response of all the nutrients	80.00	84.25	82.13	87.44	98.88	93.16

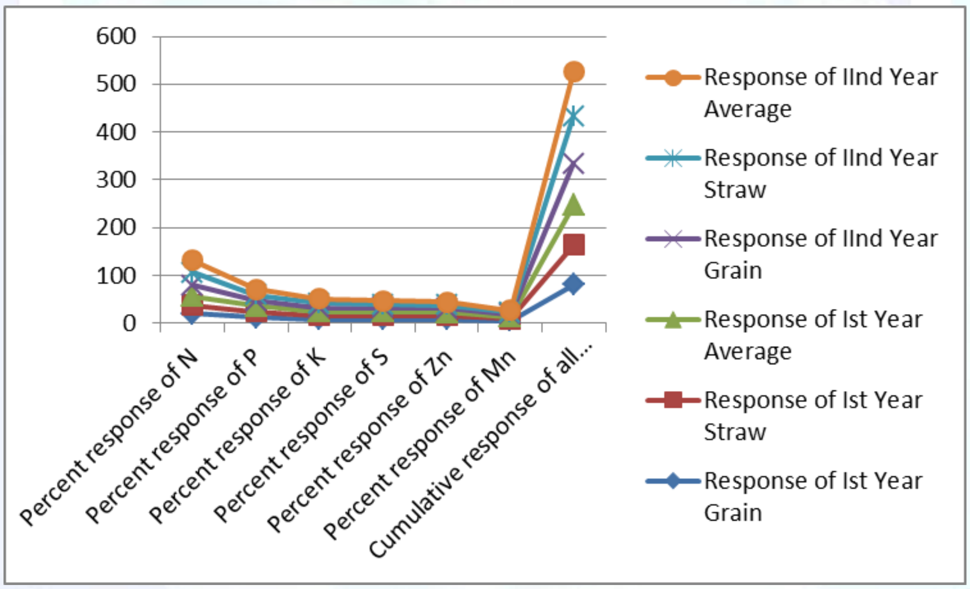

Figure.2 Portioning of responses of individual nutrients (%)

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