EUROPEAN ACADEMIC RESEARCH
Vol. II, Issue 9/ December 2014

Impact Factor: 3.1 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

Amendment of Saline-Alkaline back Cotton Soil with Peg for *Oryza Sativa* L.

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Abstract:

Salinity constitutes the most stringent factor in limiting plant growth thereby the agricultural productivity. Effect of different concentrations of PEG (5 ppm, 10 ppm, 15 ppm, 20 ppm, 25 ppm and 30 ppm) was studied on the germination, seedling growth, root-shoot biomass and chlorophyll contents of Oryza sativa L. cv. Krishna hamsa. PEG treatment has been found effective to increase germination and early seedling growth. Germination and almost all the morphological parameters including the chlorophyll a, chlorophyll b and total chlorophyll contents showed increase in all PEG treated sets.

Key words: Germination, Biomass, Chlorophyll, Root length, Shoot length, Soil salinity, *Oryza Sativa* L.

Introduction:

Rapid increase in human population in developing countries, more particularly in India, during last few decades has put a tremendous pressure on existing natural resources including soil and food resources. Paddy (*Oryza sativa* L.) is an important cereal crop in India, hence may be needed its large scale production. Moreover, the excessive increase in population

demands to increase the total yield. Rice is one of the most effective and commercial means of reclaiming hundreds of thousands of hectares of saline lands in India, if cultivated effectively and efficiently by advanced methods. Salinity is one of the major obstacles in enhancing rice production as it decreases germination and reduces the growth of shoot, root and biomass. Therefore, development of salt tolerant varieties or the uses of soil amendments for reclamation of salinity have been considered as suitable strategies to increase rice production in saline prone areas. The objectives of this research were to study the performance of paddy crop under salinity stress if treated with Polyethelene Glycol (PEG) as soil amendment under laboratory conditions. Keeping the above facts in view, present investigations were carried out.

Materials and Methods:

The soil samples from upper layer (25 cm) of non saline and saline soil were collected in polythene bags from the agricultural field of village Pakni, District Solapur and analysed for their physico-chemical parameters using standard methods (Goel and Trivedi, 2000; Guptta, 2002). Polyethylene glycol (PEG) is a form condensation polymers of ethylene oxide water with general formula $H(OCH_2CH_2)_n$ OH, where n is the average number of repeating oxyethylene groups typically from 4 to about 180. It is non-toxic, odourless, neutral, lubricating, non-volatile and non-irritating and is water soluble, also soluble in organic solvents including aromatic hydrocarbons except aliphatic and is tried as an amendments for saline soil (Chavan, 2014). The experiments were conducted in Environmental Laboratory, with healthy and uniform seeds paddy rice (*Oryza sativa* L.) cv. Krishna hamsa, procured from local store in sterilized polythene bags and bioassay was conducted to test with Polyethelene Glycol (PEG) to insure its effectiveness in overcoming the salt stress on the *Oryza sativa* L. Seeds of

Oryza sativa L. were thoroughly washed with tap water for 5 minutes, surface sterilized with 10 : 1 distilled water/ bleach (commercial NaOCl) solution for 5 minutes and then 5 times with autoclaved distilled water (Ali et al., 2013). These seeds were then exposed to hydro priming at room temperature for 2 days (Ibrahim et al., 2013) and allowed to germinate in 20 cm diameter Petri plates with a tight-fitting lid.

Hundred grams of saline-alkaline black cotton soil was crushed, homogenized and leachate was prepared by stirring for 10 minutes, settled for 10 minutes and then the supernatant (soil suspension) was used for preparing different PEG treatment concentrations of 5, 10, 15, 20, 25 and 30ppm to water the experimental sets (Chavan, 2013; Chavan, 2014). A set of control prepared with the non-saline soil along with another set as blank consisted of only saline soils were maintained simultaneously. Required number of seeds of each treatment was placed in Petri plates lined with double layer of Whatman filter paper No. 42, moistened with supernatant solution of desired PEG treatment concentration keeping one set of four replicas as control. The papers in each set were replaced daily and moisturized daily with fresh treatment solutions to avoid accumulation of salts. Seeds with a radical growth of alteast 3 mm or longer were measured from epiocotyl-hypocotyl interface to the tip of radical for germination count. The percentage was calculated by dividing total number of seeds germinated on respective day with total number of seeds taken for germination per plate and multiplied by 100. The radical (root) and plumule (shoot) length were measured with marked centimeter scale and total number of roots was counted manually. Necessary fresh weights were measured with electrical single pan balance on eighth day. Total Chlorophyll (Total Chl), Chlorophyll a (Chl a), and Chlorophyll b (Chl b) contents were determined according to the method of Torrecillas *et al.* (1984) and Kahlaui et al. (2011).

Results and Discussion:

The Physico-chemical parameters of saline-alkaline black cotton soil and the non-saline soil (control) used were studied and results are presented in Table 1. The saline soil was alkaline with pH 8.72 and EC 0.88 having poor organic carbon (0.21%) and organic matter (0.362%) reflecting it as unfit for agricultural cultivation. The non-saline (control) soil was having pH 7.2, organic matter 0.383% and organic carbon 0.23% which was slightly higher than the saline-alkaline black cotton soil. SAR value for saline-alkaline black cotton was 3.71 whereas for non-saline (control) soil, it was 4.75.

Table 1: Physico chemical Properties of saline alkaline black cotton soil and control soil

Parameter	Saline Soil	Control Soil
pH	8.72	7.2
EC	0.88	0.91
Organic carbon (%)	0.21	0.23
Organic matter(%)	0.362	0.383
Ca (cmol/kg)	1.32	1.21
Mg(cmol/kg)	0.46	0.52
Na(cmol/kg)	4.94	4.42
SAR	3.71	4.75

No any germination or seedling survived in untreated saline-alkaline black cotton soil (blank). Hence, no data was obtained from blank set and not considered for further data analysis. The presence of soluble salts in the plant growth media is a major factor that reduces the seed germination and crop growth (Chavan, 2013). Agricultural crops are sensitive to stress in their early seedling growth stages. Once the crop grows and passes these stages, it can often tolerate and grow well in higher salinity conditions (Rehman *et al.*, 1996; Chavan, 2014). In view to such goal, Polyethylene Glycol (PEG) studied in present investigation was found beneficial for the paddy crop (*Oryza sativa* L.).

Table 2: Effect of PEG on the seed germination (%) at different periods in *Oryza sativa* L.

Treatment	Germination percentage in *Oryza sativa* L.				
Expt. set	**1st Day**	**2nd Day**	**3rd Day**	**4th Day**	**5th Day**
Control	26.50(±1.1)	65.75(±1.0)	79.75(±1.0)	88.00(±1.3)	88.25(±1.5)
05 ppm PEG	28.00(±0.5)	76.25(±1.8)	84.50(±1.4)	88.75(±1.1)	89.00(±1.9)
10 ppm PEG	28.25(±2.1)	78.00(±1.8)	86.00(±1.6)	87.25(±1.0)	87.75(±1.8
15 ppm PEG	27.25(±1.6)	75.50(±2.0)	86.25(±1.3)	88.00(±1.8)	88.00(±0.3)
20 ppm PEG	27.50(±0.7)	69.25(±1.2)	75.75(±1.7)	76.25(±1.6)	76.25(±0.5)
25 ppm PEG	27.50(±1.3)	66.50 ±1.6)	75.25(±1.5)	75.75(±1.1)	76.50(±1.1)
30 ppm PEG	7.25 (±1.5)	63.25(±0.5)	73.25(±0.5)	73.50(±1.6)	74.00(±2.1)

Bracket values indicates SD.

Table 3: Effect of PEG on different morphological growth parameters of *Oryza sativa* L. per seedling indicating mean with respective standard deviation in bracket.

Growth Parameter	Control	5 ppm PEG	10 ppm PEG	15 ppm PEG	20 ppm PEG
Root length (g)	8.30 (±0.31)	10.02(±0.42)	10.69(±0.46)	10.64(±0.60)	9.19(±0.46)
Shoot length (g)	16.36(±0.82)	17.19(±0.70)	17.32(±0.45)	17.34 (±1.0)	16.53(±0.86)
No. of roots	8.00 (±0.40)	9.25 (±0.42)	11.50(±0.48)	12.25(±0.60)	8.25 (±0.32)
Root biomass(g)	0.154(±0.02)	0.157(±0.03)	0.159(±0.03)	0.161(±0.06)	0.156(±0.04)
Shoot biomass(g)	0.159(±0.03)	0.168(±0.02)	0.173(±0.12)	0.162(±0.06)	0.158(±0.02)
Chl. 'a' (mg/g)	0.093(±0.04)	0.096(±0.06)	0.108(±0.01)	0.113(±0.04)	0.103(±0.03)
Chl. 'b' (mg/g)	0.055(±0.04)	0.067(±0.05)	0.094(±0.05)	0.109(±0.02)	0.093(±0.05)
Total Chl.(mg/g)	0.146(±0.01)	0.153(±0.02)	0.162(±0.02)	0.181(±0.03)	0.174 (±0.02

The results reveal that the root, shoot and chlorophyll contents were well improved against the salt stress and seedlings were well nourished by PEG treatment (Table 3). Root length and shoot length in control set were 8.30 (±0.31) and 16.36 (±0.82) which were lowest as compared with respective lengths in PEG treated sets. Number of roots was found improved in 5 to 25 ppm PEG concentrations but decreased at 30 ppm indicating

slight phyto-toxicity evidenced by reduced biomass and chlorophyll contents. The chlorophyll contents have been found increased with increase in the PEG concentration up to 25 ppm in treated saline-soil and decreased thereafter.

Conclusion:

From the results of this investigation, it is evident that the PEG can be recommended as one of the treatment solution for the amendment of saline soil to cutivate paddy crop (*Oryza sativa* L.)

REFERENCES:

Ali M. K. (2013). Rice (*Oryza Savita* L) candidates against global warming. *Annals of Bioogical research*, 4(8):9-16.

Chavan, B.L (2014). Treatment of saline-alkaline black cotton soil with PEG for germination and growth of *Triticum aestivum* seedlings, *Int. J. Res.in Mgmt. & Bus. Stud.* 1(4), 23-26, also available also at www.ijrmbs.com.

Chavan B.L. (2013) Sustainable and cost effective treatment for the reclamation of saline alkaline black cotton soil, *Final technical report on the Major Research Project* submitted to UGC, New Delhi.

Goel, P.K. and Trivedi, R.K. (2000). *Methods in environmental analysis water, soil, air*. Handbook, Environmental Publication, Karad.

Guptta, P.K. (2002). *Methods in environmental analysis water, soil and air*. Handbook, Agrobios publication, Jodhpur, Rajasthan, India

Kahlaoui, B. M. Hachicha, S. Rejeb, M.N. Rejeb, B. Hanchi and E. Misle, (2011). Effect of saline water on tomato under subsurface drip irrigation: Nutritional and foliar aspects, *J. Soil Sci. Plant Nutr.* 11 (1): 69 – 86.

Kapoor R.T.(2011). Salinity -induced changes in germination, biomass and physiological characteristics of *Oryza sativa* L. International conference of advance in Biotechnology and Pharmaceutical sciences (*ICABPS*), 2011.

Ibrahim N.D., Z. Bhadmus and A. Singh (2013) Hydro-priming and Re-drying effects on germination, emergence and growth of upland rice (Oryza sativa L.), *Nig. J. of Basic and App. Sc.*, 21(2), 157-164, also available at http://www.ajol.info/index.php/njbas/index.

Rehman, S., Harris P.J.C, Bourne W.F. and Wilkin J. (1996). The effect of sodium chloride on germination and the potassium and calcium content of Acacis seeds. *Seed Sci. and Technol.*, 25: 45-57.

Torrecillas, A., Leon, A., Del Amor, F., Martinez-Monpean, M.C. (1984). Determinacion rapida de clorofila en discos foliares de limonero. *Fruits*, 39, 617-22.