World Journal of Agricultural Sciences 5 (4): 422-424, 2009
ISSN 1817-3047
© IDOSI Publications, 2009

Response of Wheat to Soil Amendments with Poor Quality Irrigation Water in Salt Affected Soil

[1]Abdur Rashid, [1]Rahmat Ullah Khan and [2]Sarfraz Khan Marwat

[1]Arid Zone Research Institute, Dera Ismail Khan, N.W.F.P., Pakistan
[2]Universit Wensam Collage, Gomal University Dera Ismail Khan, N.W.F.P., Pakistan

Abstract: The experiment was conducted on farmer's field at District Lakki Marwat (NWFP) during Rabi (spring) 2007-08, in order to study the response of wheat to different soil treatments irrigated with poor quality irrigation water. The treatments including control, tillage, gypsum and sulphuric acid were applied before sowing of the wheat crop. The treatments were arranged in a randomized complete block (RCB) design with three replications. The data revealed that soil amendments significantly improved the growth and grain yield of wheat. Plant height, number of tillers plant^{-1}, number of grains spike^{-1} and 1000 grains weight were significantly increased with all the soil treatments over control crop. Regarding grain yield, all the inputs enhanced the yield over control, whereas gypsum performed significantly well when applied in combination with deep tillage. The highest grain yield of 3989 kg ha^{-1} was obtained from combined application of deep tillage + 100% gypsum requirement of the soil showing 59.87% increased over control. Thus, it may be concluded that deep tillage and gypsum both in combination proved more effective in combating ill effects of salts and improving wheat yield in salt affected soil.

Key words: *Triticum aestivum* L. · Gypsum · Deep tillage · H_2SO_4 · Grain yield

INTRODUCTION

In Pakistan, 6.68 million hectare is salt affected constituting about 26% of the irrigated land where in salinity and sodicity have been major constraints of agricultural production. Khan [1] reported that a sizeable proportion of good productive land ranging from about 10-15% consists a special type of "Patchy" or sparse salinity/sodacity. Saline soils can easily be reclaimed by simple leaching with good quality water but the sodic and saline-sodic soils needs replacement of the exchangeable sodium form the exchange complex with calcium which is than leached down beyond the root zone. Different strategies including ploughing, leaching, use of chemical amendments and fertilization help plants growth in salt affected soils. Gypsum, the most effective source of soluble calcium to replace exchangeable sodium from exchange complex is very commonly used in reclamation of saline-sodic and sodic soils [2-5].

Research findings revealed that HCL and H_2SO_4 had significantly positive effect on tillering, plant height, grain and straw yield of wheat [6, 7]. Similarly, Wasif *et al.* [8] and Mughra *et al.,* [9] reported that soil amendments helped in increasing the crop yield on calcareous soil under saline irrigation water. Haq *et al.* [10] indicated that the maximum increases in number of spikes m^{-2}, number of grains spike^{-1}, 1000 grains weight, straw and grain yield were 128, 48, 47, 34 and 133%, respectively in case of combined application of gypsum @ 100% GR and manure @ 10 tones ha^{-1} over control. In light of potential of soil amendments for increased crop production in salt affected soil, this study was conducted to determine the effect of different strategies for wheat production in problem soil of NWFP (Pakistan).

MATERIALS AND METHODS

This trial was carried out at the farmer's field, District Lakki Marwat during 2007-08 to study the effect of soil amendments on the yield of wheat in salt affected soils. The experiment was laid out according to the randomized complete block design (RCB) with three replication on a net plot size of 10 x 3 m. Soil samples from 0-30 cm depth were collected to determine gypsum requirements and soil properties of the field (Table 1).

Corresponding Author: Sarfraz Khan Marwat, Universit Wensam Collage, Gomal University Dera Ismail Khan, N.W.F.P., Pakistan

Table 1: Soil characteristics of experimental field

Soil Depth	Parameter	Unit	Value
0-30 cm	pH		8.3
	ECe	dSm^{-1}	4.10
	CO_3	$MeqL^{-1}$	Nil
	HCO_3		1.32
	OM	%	0.81
	N		0.040
	GR	t $acre^{-1}$	1.032
	Sand	%	14.40
	Silt		82.80
	Clay		2.80
	Textural calss		Silt

The treatments applied well ahead the sowing of crop were control (TI), deep tillage (T2), gypsum application @ 100 % GR (T3), deep tillage + 100% GR (T4) and acid application (T5) on equivalent basis of gypsum requirement of the soil. Deep tillage (30 cm) and 100% gypsum were applied uniformly before flooding the field and sulphuric acid **(concentration in irrigation water .. ????)** was mixed in the irrigation water to the respective plots. So that, the salts can be dissolved and leached down to reduce the harmful effects on plants growth. Wheat variety "Bakhtawar" was sown @ 120 kg ha^{-1} during first week of December, 2007. A basal dose of 90-60 kg ha^{-1} was applied uniformly at the time of seed bed preparation. All the agronomic practices were kept normal and uniform for all the treatments of experiment. Different observations were recorded on various agronomic characters of the crop. The data collected were analyzed statistically by using the analysis of variance (ANOVA) technique [11] and Duncan`s Multiple Range Test (DMRT) was employed at 5% probability level for comparison among the treatments means [12].

RESULTS AND DISCUSSION

Data in Table 2 indicated that the yield components and grain yield had significantly affected by different soil treatments in the salt affected soil. Data also revealed that the plant height was significantly increased with either inputs alone or in combination over control. The maximum plant height, (77.85 cm) was recorded in the treatment of deep tillage + 100% gypsum application as per soil requirement. Wherein, the lowest plant height (71.38 cm) was recorded in control treatment. These results suggested that treatment of deep tillage and gypsum application might have ameliorated the injurious effect of salts in the field which ultimately showed positive effect on the plant growth and increased plant height of wheat. Similar effect was observed in the number of tillers $plant^{-1}$ of wheat. The combined application of deep tillage and 100% gypsum application produced more tillers $plant^{-1}$ (2.68) followed by 2.17 tillers $plant^{-1}$ with $H_2 SO_4$ compared to 1.62 tillers $plant^{-1}$ obtained from control plot. These results are in harmony with the findings of Rashid and Majid [6] and Akhtar and Niazi [7].

Data in Table 2 that the number of grains $spike^{-1}$ of wheat at different soil treatments have significantly affected. The highest number of grains $spike^{-1}$ (50.75) of wheat was recorded in the treatment of deep tillage + 100% gypsum application followed by 49.25 grains $spike^{-1}$ obtained with 100% gypsum application alone. The lowest numbers of grain $spike^{-1}$ (44.50) was recorded in the treatment of control. Data also indicated that thousand grains weight of wheat had significantly affected by different soil treatments. The highest thousand grains weight (44.12 g) was recorded in the treatments of deep tillage + 100% gypsum application showing non-significant difference with 43.66 and 43.93 g from 100% gypsum application alone and H_2SO_4,

Table 2: Yield components of wheat affected by soil amendments during 2007-08

Treatments	Plant height (cm)	Tillers $plant^{-1}$	Grains $spike^{-1}$	1000 grains weight (g)
T_1 Control	71.383^{d}	1.617^{c}	44.500^{d}	41.413^{c}
T_2 Deep tillage	73.350^{c}	1.917^{b}	48.667^{b}	42.498^{b}
T_3 100% gypsum application	74.933^{b}	2.142^{b}	49.250^{b}	43.668^{a}
T_4 Deep tillage + 100% GR.	77.850^{a}	2.683^{a}	50.750^{a}	44.120^{a}
T_5 Acid application	74.300^{bc}	2.167^{c}	47.167^{b}	43.932^{a}
LSD (0.05)	1.033	0.252	1.263	0.837

*Means followed by similar words do not differ significantly at 5% level of probability

Table 3: Grain yield data of wheat affected by soil amendments during 2007-08

Treatments	Grain Yield kg ha^{-1}	% increase over control
T_1 Control	2495^{e}	--
T_2 Deep tillage	3035^{d}	21.64
T_3 100% gypsum application	3515^{b}	40.88
T_4 Deep tillage + 100% GR.	3989^{a}	59.87
T_5 Acid application	3183^{c}	27.57
LSD (0.05)	146	

*Means followed by similar words do not differ significantly at 5% level of probability

respectively. These results confirmed the help of soil amendments on the development of grains which ultimately increased the grains weight of wheat. These results were corroborated with Haq *et al.* [10].

Data presented in Table 3 showed that the grain yield significantly increased with all the soil treatments over control crop yield of 2495 kg ha^{-1}. This yield increase ranged from 21.64 to 59.87% with different soil treatments. The highest yield increase of 59.87 % was recorded in the treatment of deep tillage + 100% gypsum application showing significant increase than all other inputs applied alone. This yield increase might be attributed to increase in grains spike^{-1} and 1000 grains weight with soil treatments. These results are in line with the findings of Wasif *et al.* [8], Rashid and Majid [6] and Haq *et al.* [10]. The findings of this study revealed that deep tillage can improve the efficiency of gypsum application in terms of combating salts affect on plants growth and increased crop production. Thus it can be concluded that combined application of deep tillage + 100 % gypsum can be recommended to end users for adoption to achieve production potential of wheat in salt affected soil of Pakistan.

REFERENCES

1. Khan, G.S., 1998. Soil sodicity status in Pakistan. Soil survey of Pakistan, Lahore.
2. Oster, J.D. and H. Frenkal, 1980. Chemistry of reclamation of sodic soil with gypsum and lime. Soil Sci. Soc. Amer. J., 44(1): 41-45.
3. Gupta, R.K., C.P. Singh and I.P. Abrol, 1985. Dissolution of gypsum in alkali soils. Soil Sci., 140(5): 382-386.
4. Ahmad, M., B.H. Niazi and G.R. Sandhu, 1988. Effectiveness of gypsum, HCL and organic matter for the improvement of saline sodic soils. Pak J. Agric. Res., 9(3): 373-378.
5. Khan, G.S., M. Ikram and A.H. Ansari, 1999. Amelioration of Patchy (Sparse) salinity/ sodicity in irrigated plain of Pakistan (A case study). Pak. J. Soil Sci., 16: 21-24.
6. Rashid, M. and A. Majid, 1983. Effect of sulphuric acid and hydrochloric acid on yield performance of IR-6. Paper presented at Rice seminar, Pak Agric Res. Council Islamabad, April, pp: 2-4.
7. Akhter, M.S. and B.H. Niazi, 1986. Nutrient dynamics during the reclamation of calcareous saline-sodic soil with hydrochloric acid. Pak. J. Agri. Res., 7(3): 221-226.
8. Wasif, M.M., M.K. Shabana and S.M. Saad, 1995. Influence of some soil amendments on calcareous soil properties and the production of wheat under saline irrigation water. Egyptian J. Soil Sci., pp: 439-451.
9. Mughra, S.E., F.A. Hashim and M.M. Wasif, 1996. The use of sulpher and organic manure for controlling soil salinity and pollution under high saline water irrigation. Egyptian J. Soil Sci., 36(1-4): 249-288.
10. Haq, I., B. Muhammad and F. Iqbal, 2007. Effect of gypsum and farm yard manure on soil properties and wheat crop irrigated with brackish water. Soil and Environ., 26(2): 164-171.
11. Steel, R.G.D. and J.H. Torrie, 1984. Principal and Procedures of Statistics. 2nd Ed. Mc Graw Hill Book Co. Snigapure, pp:173-177.
12. Duncan, D.B., 1955. Multiple Range and Multiple F-test. Biometrics, 11: 1-42.