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Effect of Salt Levels and Cropping Methods on Wheat Agronomic Characteristics

[1]Mahdi Khozaei, [1]Ali Soleimani, [2]Mohammad Feizi and [1]Payam Najafi
[1]Department of Agronomy and Plant Breeding,
Faculty of Agriculture Islamic Azad University, Branch of Khorasgan
[2]Department of Soil and Water Research,
Isfahan Agricultural and Natural Resource Research Center, Isfahan, Iran

Abstract: The purpose of this study was to evaluate the effect of Salt levels and Cropping methods on wheat agronomical characteristics. A Split plot layout within Randomized Complete Block Design with four replication was used. Irrigation water quality were in main plots, it consists in 4, 8 and 12 dS m^{-1} and Cropping methods were in sub plots that inclusive of traditional cropping, 60 cm furrow, 80 cm furrow and aside sloping 80 cm furrow with double row planting. The results shows the effect of salinity stress on 1000 grain weight, grain yield, sum of tiller, amount of germinated tiller, amount of kernel per spikelet and amounts of spikelet were measured decreased significantly. Effect of cropping methods on LAI, TDW and grain yield were more significantly. The greatest amount of LAI, TDW and grain yield were in 60 cm furrow where as, the lowest of LAI and grain yield were in a side sloping 80 cm furrow in case, the lowest of TDW obtained in traditional cropping method. Effect of cropping method on other measured factors were not significant. Interaction of salt treatments and cropping methods on LAI, TDW and grain yield were more significant where as, the highest amount of LAI, TDW and grain yield in 4 dS m^{-1} belong to traditional cropping method with exceptional of TDW that was in 60 cm furrow the traits declined significantly in a side sloping 80 cm furrow with the rising salinity stress in 12 dS m^{-1}. According to this study the suitable method with the highest traits agronomy in low salinity (4 dS m^{-1}) and high salinity (12 dS m^{-1}) were traditional cropping method and 80 cm furrow method, respectively.

Key words: Salinity stress, cropping method, grain yield, LAI, TDW

INTRODUCTION

Excess amount of salt in the soil adversely affects plant growth and development. Nearly 20% of the world's cultivated area and nearly half of the world's irrigated lands are affected by salinity (Zhu, 2001). Salinity is a major constraint to crop production in the arid and semiarid areas of the world, where low precipitation, high surface evaporation, irrigation with saline water, rising water tables and poor irrigation practices increase level of soil soluble salts (Ashraf, 1994; Hollington, 1998). Processes such as seed germination, seedling growth and vigor, vegetative growth, flowering and fruit set are adversely affected by high salt concentration, ultimately causing diminished economic yield and also quality of produce. Water deficit associated with salinity in irrigation water is the major limiting factor in the center and east of Iran where plants are subjected to extreme water deficit during the season. In this climatic condition, salts may accumulate in the soil because of high evaporative demand and insufficient leaching of ions because of low precipitation (Feizi, 1988). The deterious effect of salinity was suggested as result of water stress ion toxicities, ion imbalance, or combination of all these factors (Kurth *et al*., 1986). In view of, 55.8% of Iran soil's contained saline soil and ions or insufficient draining, the most of that are in Khozestan and Fars County with 32.89 and 16.43, respectively. On the other hand, resource of irrigation water quality continued too much salts and ions (Keyani, 2001). For cropping plants in those area. It was necessity to investigation of usage new cropping methods in salinity stress in irrigated farming meanwhile, according to sustainable agriculture and attention of agriculture economy which caused to raise economic yield and agronomic characteristic. Bernstein (1955) concluded some research about seed bed and cropping methods in salinity stress, he showed distances between planting rows and furrow caused to lower deterious effect of ions and concentration of salts in root zone's and stem. Also, rising seed bed could declined confronting of plant to direct side effect of salts toxicity. The aim of this study as regards to geographical occasion of Iran, which established some arid and semi arid in center, east and north east with the minimum annul rainfall, to evaluate the

Corresponding Author: Mahdi Khozaei, Department of Agronomy and Plant Breeding, Faculty of Agriculture, Islamic Azad University, Branch of Khorasgan Tel: 00983115239491 Fax: 00983115213482

effect of cropping methods and salinity stress on wheat agronomic characteristics.

MATERIALS AND METHODS

This experiment was conducted at Rudasht Salinity Research Station Located in Province with 52/11' longitude and 32/29' latitude in Oct., 2004. The ecoclimate of Rodasht is arid to semiarid with of 100 mm rainfall. A split plot layout within Randomized Complete Block design with four Replications were used. Irrigation water qualities were in main plots, it consists in, 4, 8 and 12 dS m^{-1}. Cropping methods were inclusive of traditional cropping, 60 cm furrow, 80 cm furrow. A side sloping 80 cm furrow with double row planting. Measurement of every plot area was 32 m^2 with number of furrow 4, 5 in 80 and 60 cm furrow cropping methods, respectively. The fertilizing were 100 kg ha^{-1} ammonium phosphate before planting and 170 kg ha^{-1} nitrogen in tow stage half before and half after planting used. After preparing Farm sown with seeds Wheat (*T. astivum*, variety *Roshan*). Before overripe a frame 15×150 cm^2 for determined LAI (Leaf Area Index) and calculated amount of shadow was used in addition to get LAI used Leaf Area Meter Set. To obtain TDW (Total Dry Weight) gathered all plants which were in frame with exception of margin also, separated leaves and others parts afterward, dried in 78°C for 48 h then weighed. After Physiological progress and development plant stage, gathered all products in every plot, which weighed with the exception of margins to obtain biological yield. Then, sifting and cleaning so, seeds of every plot weighed to aim of grain yield. Counted 500 seed from every plot with seed counter Set then, weighed and twofold it was 1000 grain weight. To obtain sum of tiller, amount of germinated tiller, amount of kernel per spikelet, amount of spikelet and plant cluster height were measured for every plot after over ripping. Statistical analyses of data were performed using MSTAT-C Program. Duncan Multiple Range Test was used to determine significant differences of means at the 5% probability level.

RESULTS AND DISCUSSION

Effect of salinity stress on LAI and TDW were more significant (Table 1). The greatest amount of LAI and TDW were in salinity 4 dS m^{-1} which traits declined significantly with the rising salt levels in 12 dS m^{-1}. Manns and Termeat (1992) reported salinity stress caused declined leaf area index and amount of photosynthesis consequently. Delane *et al.* (1982) believed salinity caused deleterious of leaf system and decreased amount of Photosynthesis. Rawson *et al.* (1988) reported TDW declined significantly due to salinity stress. Effect of salt treatments on 1000 grain weight, grain yield, sum of tiller, amount of germinated tiller, amount of kernel per spikelet and amount of spikelet were more significant in addition of mentioned factors, effect of salinity on plant cluster height was significant at 5% probability level (Table 1). Afzal (2004) reported Augmented salts concentration caused deducted significantly on amount of kernel per spikelet, grain weight per spikelet and 1000 grain weight Basically, seeds weight, controlled with period and filled up nutrient material rate also, amount of kernel per spikelet (Kirby, 1974). Amount of 1000 grain weight, grain yield, sum of tiller, amount of germinated tiller, amount of kernel per spikelet, amount of spikelet and plant cluster height decreased significantly under rising salt treatments (Table 2). Nevertheless, the greatest of traits were in salinity 4 dS m^{-1} while, the lowest were in salinity 12 dS m^{-1}. Mass and Grieve (1988) reported that the main effected of salinity stress to decline grain yield due to decreased amount of germinated tiller and amount of spikelet, agreed of that Cerda *et al.* (1978). Effect of cropping methods on LAI, TDW and grain yield were more significant (Table 1). The greatest amount of LAI, TDW and grain yield were in 60 cm furrow while, the lowest were in a side sloping 80 cm furrow with the exception of TDW which was in traditional cropping method (Table 2). Cropping methods did not affected significantly on 1000 grain weight, sum of tiller, amount of germinated tiller, amount of kernel per spikelet, amount of spikelet and plant cluster height (Table 1). By this planting method soil and water salts still concentrate near the center of the bed but away from the seed rows and germination is likely to be better if salinity is a problem (Ayers, 1985). Interaction of salt treatments and cropping methods on LAI, TDW and grain yield were more significant (Table 1). In salinity 4 dS m^{-1} the greatest of LAI obtained in traditional cropping method where as, the lowest belonged to a side sloping 80 cm furrow method, the 80 cm furrow had most amount of LAI after traditional cropping method which had significant difference as compared to others cropping methods (Fig. 1). In salinity 8 dS m^{-1} the greatest LAI obtained in 60 cm furrow although, the lowest amount of LAI was in a side sloping 80 cm furrow method, there were not any significant difference in amount of LAI between 60 cm furrow and 80 cm furrow. In salinity 12 dS m^{-1} the highest LAI obtained in 80 cm furrow while, the lowest belonged to a side sloping 80 cm furrow method also, there were no any significant difference between amount of

Table 1: ANOVA analysis LAI, TDW, grain yield, 1000 grain weight, sum of tiller, germinated tiller, amount of spikelet, kernel per spikelet and plant cluster height

		Means square								
Source of variation	df	LAI	TDW ($g\ m^{-2}$)	Grain yield ($kg\ ha^{-1}$)	1000 grain weight (g)	Sum of tiller	Germinated tiller	Amount of spikelet	Kernel per spikelet	Plant cluster height (cm)
Repeat (Block)	3	17.390	127.821*	26.518	50.583*	1.212	0.021	1.532	24.167	0.688
Salinity	2	349.177**	302.285**	196.854**	711.750**	88.340**	64.250**	14.222**	401.583**	14.741*
Error (a)	6	5.2765	15.310	23.233	7.750	6.139	2.846	0.921	48.500	2.576
Cropping methods	3	24.6608**	180.988**	50.393**	17.917	4.645	0.436	0.188	331.500	2.258
Interaction of salinity and copping methods	6	2.2632**	22.981**	36.556**	23.417	1.108	1.158	0.279	20.500	1.137
Error (b)	27	0.6699	5.554	6.041	10.713	1.799	1.114	1.151	12.759	1.951

** and * significant at the 5 and 1% probability Levels, respectively

Table 2: Means comparison salt levels and cropping methods on LAI, TDW, grain yield, 1000 Grain weight, sum of tiller, kernel per spikelet and plant cluster height germinated tiller, amount of spikelet

	Means square								
Source of variation	LAI	TDW ($g\ m^{-2}$)	Grain yield ($kg\ ha^{-1}$)	1000 grain weight (g)	Sum of tiller	Germinated tiller	Amount of spikelet	Kernel per spikelet	Plant cluster height (cm)
Salinity									
4 $dS\ m^{-1}$	1.23a	23.02a	7594a	35.00a	8.837a	7.016a	15.40a	45.38a	7.94a
8 $dS\ m^{-1}$	0.65b	15.62b	2347b	24.50b	5.761b	5.128b	14.74a	42.250a	7.86a
12 $dS\ m^{-1}$	0.128c	15.94b	842.8c	22.63b	4.222b	3.011c	13.54b	35.63b	6.24b
Cropping methods									
Traditional cropping	0.1348b	8.217c	3243c	27.42a	6.387ab	5.082a	14.44a	41.17b	7.91a
60 cm furrow	0.152a	23.02a	4212a	28.50a	6.143ab	5.003a	14.69a	39.67b	7.45a
80 cm furrow	0.1094c	15.62b	40.35b	27.92a	5.529b	4.832a	14.47a	40.42ab	7.02a
A side sloping 80 cm furrow	0.0053d	15.94b	2890d	27.67a	7.033a	5.291a	14.66a	43.42a	6.99a

All means followed by the same letter in column are not significantly different at the 5% probability level

LAI in 60 cm furrow and 80 cm furrow (Fig. 1). In salinity 4 $dS\ m^{-1}$ the highest amount of TDW was in 60 cm furrow while, the lowest was in aside sloping 80 cm furrow (Fig. 2). The greatest of TDW in salinity 8 $dS\ m^{-1}$ obtained in 60 cm furrow where as, the lowest of TDW depend on aside sloping 80 cm furrow also, there were not any significant difference in amount of TDW in traditional cropping method and aside sloping 80 cm furrow. In salinity 12 $dS\ m^{-1}$ the greatest of TDW obtained in 80 cm furrow that had not significant difference with 60 cm furrow although, the lowest of TDW gained in traditional cropping method (Fig. 2). In salinity 4 $dS\ m^{-1}$ the greatest amount of grain yield obtained in traditional cropping method though, the lowest of grain yield was in a side sloping 80 cm furrow method, the 80 cm furrow had most amount of grain yield after traditional cropping method which had significant difference as compared to other cropping methods (Fig. 3). In salinity 8 $dS\ m^{-1}$ the highest amount of grain yield was in 80 cm furrow while, the lowest of that was in aside sloping 80 cm furrow method. In salinity 12 $dS\ m^{-1}$ the greatest amount of grain yield was in 80 cm furrow where as, the lowest sharply declined in aside sloping 80 cm furrow, the greatest of grain yield since 80 cm furrow was in 60 cm furrow which had significant difference compared to another's cropping methods (Fig. 3). Excess of salt creates osmotic stress by a decline in water potential producing negative effect

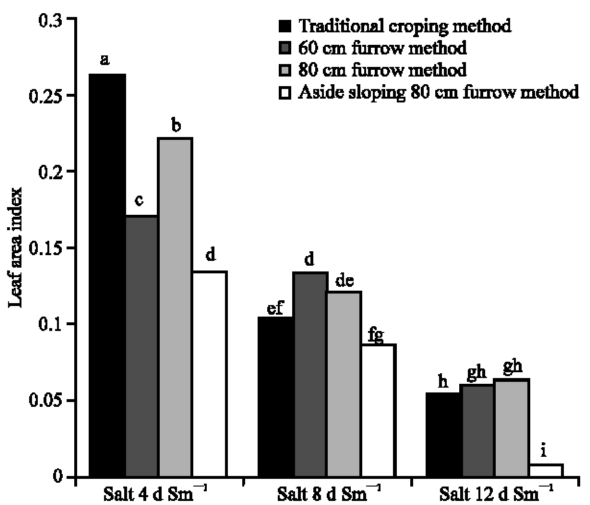

Fig. 1: Means of comparison LAI in reaction of salt treatments and cropping method

on physiology processes. The some negative effect have also been reported by Sheveen *et al.* (2001). Afzal (2004) reported salinity imposed with 20 $dS\ m^{-1}$ saline water reduced grain yield compared with control and 10 $dS\ m^{-1}$ saline water by 25 and 37%, respectively. In fact, the 80 cm furrow in high salinity was suitable distance between planting rows which shown the highest yields because of distance encourage plant to growth and

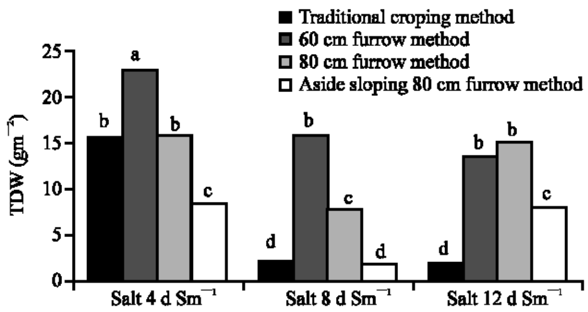

Fig. 2: Means of comparison TDW in reaction of salt treatments and cropping method

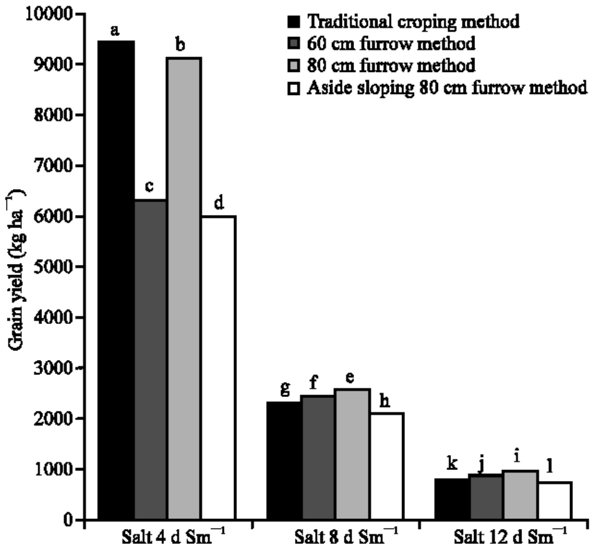

Fig. 3: Means of comparison grain yield in reaction of salt treatments and cropping method

development procedure so, with the diminish of exceed ions and salts. It seems in salinity 4 dS m^{-1} were not any foes of ions and salts on growth development of plants, on the contrary, in salinity 12 dS m^{-1} there were much force on stages of growth. Cerda and Bingham (1978) believed the reason of declined the grain yield and straw yield due to diminish amount of tillers and clusters. Creation distance between planting rows in salt treatments 8, 12 dS m^{-1} reduction deterious and side effect as result of salt concentration on plant growth. On the contrary, assembling salt and excessive ions between planting tow row of a side slopping 80 cm furrow also, concentration of salts near the root and stem in traditional cropping method in high salinity stress caused risen osmotic pressure and declined up took mineral nutrients. Growth and development of plants are inhibited due to occurring defect in metabolism. Some investigators thought that because of ion accumulation by changing membrane permeability, metabolism was negatively in flounced (Cramer *et al.*, 1985; Grieve and Fujiyama, 1987). In conclusion, with the rising salinity stress in arid and semiarid where low precipitation, high surface evaporation, irrigation with saline water the ions and salts concentrated so, the beneficiary way was creates rising plant bed with the suitable distance. To avoid of deterious effect. In present study in low salinity (4 dS m^{-1}) and in high salinity (12 dS m^{-1}) the best chosen were traditional cropping method and 80 cm furrow, respectively which showed the highest amount of agronomic characteristics.

REFERENCES

Afzal, Y., 2004. Determine crisis period of sensitivity to salinity tows wheat cultivars. M.Sc. Thesis, Azad Khorasghan University.

Ashraf, M., 1994. Breeding for salinity tolerance in plant. Crit. Rev. Plant Sci., 13: 17-42.

Ayers, R.S. and D.W. Westcot, 1985. Water quality for agriculture. FAO. Rev., 29: 44-46.

Bernstein, L., M. Fireman and Reve, 1955. Agricultural Res. Service. Bull 41(4). Is P.R.C. Control of Salinity in the Imperial Valley. US Department of Agriculture.

Cerda, A. and F.T. Bingham, 1978. Yield, mineral Composition and salt tolerance of tomato and wheat b as effected by NaCl an nutrition. Agrochemica, 22: 140-142.

Cramer, G.R., A.L. Uchli and V.S. Polite, 1985. Displacement of Ca^{+2} by Na^{+} form: The plasma lemma of root cells. Plant Physiol., 979: 207-211.

Delane, R.H., H. Greenway, R. Munns and J. Gibbs, 1982. Ion concentration and carbohydrate status of clongating leaf tissue of *Hordeum vulgar* growing at high external NaCl. J. Exp. B.T., 33: 557-543.

Feizi, M., 1998. Quality water affect on wheat product yield. Annul report. Isfahan Agric. Res. Center No. 77/282.

Grieve, C. and M.H. Fujiyama, 1987. The response of tow rice cultivars to external Na Cl^{-1} ratio. Plant and Soil, 103: 245-250.

Hollington, P.A., 1998. Technological Breakthroughs in Screening and Breeding Wheat Varieties for Salt Tolerance. In: Proceedings of the National Conference on Salinity Management in Agriculture CSSPI. Gupta, S.K., S.K. Sharma and N.K. Tyagi (Eds.), Karnal, India, pp: 273-289.

Keyani, A., 2001. Executive methods and management of usage salinity water. First National Conference to Check Lack of Water. Zabol. Dec., 2001.

Kirby, E.J.M., 1974. Ear development in wheat. J. Agric. Sci. Camb., 2: 437-447.

Kurth, E., G.R. Cramer, A. Lauchli and E. Epstein, 1986. Effects of NaCl and $CaCl_2$ on cell enlargement and cell production in cotton roots. Plant Physiol., 82: 1102-1106.

Mass, E.V. and C.M. Grieve, 1988. Salinity Effect on Apex development in Wheat. US Salinity Lab. Biennial Rep.

Monns, R., 2002. Comparative physiology of salt and water stress. Plant, Cell Environ., 25: 239-250.

Munns, R. and A. Termaat, 1992. Whole-plant response to salinity. Aust. J. Plant Physiol., 130: 143-160.

Rawson, H.M., R.A. Richarda and R. Munns, 1988. An examination of selection criteria for saltz tolerance in wheat. barly and triticole genotypes. Aust. J. Agric. Res., 39: 759-772.

Sheveen, A., R. Ansari and A.Q. Soomrom, 2001. Salt tolerance in salinity toxicity. Quantitative resolution of multiple toxic and ameliorative effects. J. Exp. B.T., 50: 1495-1502.

Zhu, J.K., 2001. Over expression of a delta-pyrroline-s-carboxylate synthesize gene and analysis of tolerance to water and salt stress in transgenic rice. Trends Plant Sci., 6: 66-72.