Response to grain yield in different varieties of maize (*Zea mays* L.) In soil salinity in the Astara region

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ABSTRACT: To study the effect of salinity experiment was performed in Astara region. Cultivars included cultivated in two pieces of land in Astara: one with normal soil and the other with salty soil. Maize cultivars were experimented in three replications on the basis of randomized complete block design. During the experiment, yield characteristics such as ear length, number of rows in ear, Number of grains per row, Number of grains per ear, Biomass per plant, Biological yield in plot and Grain yield in plots were measured. In Saline conditions, the maximum ear length was seen in KSC689; which with other genotypes was difference significant. In The number of rows per ear in both normal and salt stress, a significant difference was observed between genotypes. The minimum number of rows per ear was observed in SC604. Grain weight per ear showed significant difference. Maximum grain weight in ear in normal conditions was observed in S.C704; that with all other varieties showed significant difference. The highest yield was observed in normal conditions in S.C704, that with KSC689, KSC647, SC301 and SC540 showed no significant difference. Lowest yield in saline conditions was observed in SC301.

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INTRODUCTION

Maize (*Zea mays* L.) occupies a key position as one of the most important cereals both for human and animal consumption and grown under various conditions in different parts of the world. Maize grain has high food value and its oil is used for cooking purposes while green fodder is quite rich in protein (Dowswell *et al*., 1996).

Earth is a predominantly salty planet, with most of its water containing about 3% NaCl. This concentration of salt has rendered the land very salty. It is projected that about 900 m ha land is affected due to salt, which considerably poses a serious threat to agricultural productivity (Flowers and Yeo, 1995; Munns, 2002) because most agricultural crops will not grow under conditions of high salt concentration. Hence, the existing salinity is a great challenge to food security. The productivity of crops is adversely affected by high salt content in most of the soils (Alam *et al*., 2000). Approximately, 7 % of the world's land area, 20 % of the world's cultivated land, and nearly half of the irrigated land is affected with high salt contents (Szabolcs, 1994; Zhu, 2001). In view of another projection, 2.1% of the global dry land agriculture is affected by salinity (FAO, 2003). More than 800 million hectares of land throughout the world are salt affected, either by salinity (397 million ha) or the associated condition of sodicity (434 million ha) (FAO, 2005). This is over 6% of the world's total land area. Most of this salinity, and all of the sodicity, is natural. However, a significant proportion of cultivated agricultural land has become saline because of land clearing or irrigation. Of the 1500 million ha of land farmed by dry land agriculture, 32 million ha (2%) are affected by secondary salinity to varying degrees. Of the current 230 million ha of irrigated land, 45 million ha are salt-affected (FAO, 2005). High amounts of salts in soils, taking into account both human made and naturally occurring salinization, are responsible for yield reduction on one third of the global arable land. Effects of salinity are more obvious in arid and semiarid regions where limited rainfall, high evapotranspiration, and high temperature associated with poor water and soil management practices are the major contributing factors

(Azevedo Neto *et al*., 2006). The evaporation rate is generally high and exceeds that of precipitation in such regions. Thus, the insufficient rainfall together with high evaporative demand and shallow ground water in most locations enhances the movement of salts to the soil surface.

Improper irrigation practices and lack of drainage have aggravated the problem leading to significant reductions in crop productivity (FAO, 2003). Selection and breeding have always been the common practices by man for the purpose of high yields and better quality of crops. Selection of crops was also made with reference to environmental conditions and the properties of soil. Historical record show a shift in agriculture in the Tigris-Euphrates basin of ancient Mesopotamia from the cultivation of wheat to the more salt tolerant barley as the fertile but poorly drained soils became increasingly saline (Jacobsen and Adams, 1958). This dynamic problem seems to be more severe when we have a glance at the increasing population, particularly in the third world countries.

Materials and Methods

To study the effect of salinity experiment was performed in Astara region. Cultivars included S.C301, S.C604, S.C540, KSC689, KSC647, S.C704, K3545.6 and Ossk602 and they were cultivated in two pieces of land in Astara: one with normal soil and the other with salty soil. Maize cultivars were experimented in three replications on the basis of randomized complete block design. During the experiment, yield characteristics such as ear length, number of rows in ear, Number of grains per row, Number of grains per ear, Biomass per plant, Biological yield in plot and Grain yield in plots ($4m^2$) were measured.

Statistical analysis of the numbers was done on the basis of randomized complete block design. The average of attendances was calculated on the basis of Duncan method at 5% probability level.

Results and Discussion

Between traits under study, between the environments, between genotype and the interaction genotype and environment, a significant difference was found (Tables 1). Ear length, as one of the yield indicators decreased with increasing salinity. Maximum ear length, in no-stress conditions in genotypes KSC689, K3545.6 and S.C704 respectively 69.55,19.20 and 19.37 cm was observed; that there was no significant difference between them. The minimum length of the ear, in SC301 was found; that was difference significant at the 5% level. Similar results were gained by Blanco et al (2008) and it was shown that together with increase in saltiness dry mass of ear wood, dry mass of leafs and stems, whole dry mass and plant height were reduced significantly.

In Saline conditions, the maximum ear length was seen in KSC689; which with other genotypes was difference significant. In The number of rows per ear in both normal and salt stress, a significant difference was observed between genotypes. Maximum number of rows per ear was observed in OSSK502 in normal conditions; which there were no significant difference with SC540. The minimum number of rows per ear was observed in SC604. Grain weight per ear showed significant difference. Maximum grain weight in ear in normal conditions was observed in S.C704; that with all other varieties showed significant difference. In Salinity conditions SC604, had the highest grain weight in ear; And with varieties S.C704, K3545.6 and KSC689 showed no significant difference. Between varieties, in total biomass per plot, was seen significant difference in normal and saline conditions. The highest biomass was observed in KSC689 which showed no significant difference with S.C704 (Tables 2). Minimum amount of this trait was obtained in SC604 of stress conditions. In plant biomass significant differences were observed between varieties. Maximum plant biomass was seen in KSC689. That with K3545/6 and S.C704 showed no significant difference. The highest yield was observed in normal conditions in S.C704, that with KSC689, KSC647, SC301 and SC540 showed no significant difference. Lowest yield in saline conditions was observed in SC301. Maximum number of grains per row in S.C704 and K3545.6 was observed. That with KSC689 showed no significant difference. The minimum numbers of grains per row were obtained in KSC647 in saline condition. Salinity reduced the number of seeds in row in all genotypes. Maximum number of grains per ear was observed in S.C704 with 610.4. That with K3545.6, Ossk502, KSC689 and SC540 had no significant difference at the 5% level. The lowest number of grains in ear in salty condition was observed in SC301.

Table 1 - Analysis of variance for maize varieties

Source	DF	Mean Square							
		Grain weight in ear	Number of grains / row	Number rows/ear	Ear length	Number of grains / ear	Biomass per plant	Biological yield in plot	Grain yield in plots
Location	1	**504.8228	**394.979	*100.33	**211.364	**271.344917	**254.613027	**951.1234	**445.2
Error	4	431.2168	071.21	570.2	139.4	633.14860	413.40406	253.21	044.0
Variety	7	**715.5303	**783.116	**752.13	**155 .31	**198.25974	**181 .83199	**012.68	^{ns}053 .0
LV	7	**893.2099	*222.32	^{ns}837 .1	**605.3	*014.10853	ns201 .13073	^{ns}475 .18	^{ns}034 .0
Error	28	386.369	309.12	288.1	092.1	838.3881	097.7390	911.9	029.0
CV%		68.17	24.13	35.7	05.7	38.14	14.18	92.22	88.15

ns. Non-significant,
* significant at 5%
**, significant at 1%

Table 2- Mean comparison traits in eight varieties of maize

	Cultivars	Grain weight in ear(g)	Number of grains/row	Number of rows/ear	Ear length (cm)	Number of grains/ear	Biomass per plant (g/plot)	Biological yield in plot (Kg/plot)	Grain yield in plots (Kg/plot)
Normal	1-KSC689	^{bc}7.156	^{ab}57.35	^{bcd}90.15	^{a}55.20	^{ab}3.592	^{a}3.774	^{a}79.26	^{ab}832.1
	2-KSC647	^{h}60.60	^{de}31.23	^{bc}85.16	^{def}40.15	^{cdef}428	^{d}297	^{efgh}73.12	^{abc}516.1
	3-OSSK502	^{defg}4.115	^{cd}39.29	^{a}02.19	^{bc}62.17	^{ab}582	^{bc}8.580	^{bc}84.20	^{bc}408.1
	4-K3545.6	^{ab}7.180	^{a}40.37	^{cde}25.15	^{a}69.19	^{ab}570	^{a}9.734	^{bcde}77.17	^{bc}470.1
	5-S.C704	^{a}1.202	^{a}93.38	^{cde}37.15	^{ab}37.19	^{a}4.610	^{ab}695	^{ab}39.23	^{a}383.2
	6-SC604	^{cd}4.144	^{cd}36.29	^{def}13.14	^{cde}19.16	^{cde}3.431	^{bc}551	^{efgd}76.13	^{bcd}264.1
	7-SC301	^{defg}109	^{cde}03.24	^{bcd}87.15	^{efg}57.14	^{def}4.389	^{bc}540	^{cdef}25.16	^{ab}945.1
	8-SC540	^{cde}7.126	^{bc}08.30	^{ab}82.17	^{cd}13.17	^{abc}5.540	^{c}3.522	^{bcd}92.18	^{ab}772.1
Salinity	1-KSC689	^{efgh}29.91	^{cd}90.28	^{cde}62.15	^{cd}75.16	^{bcd}3.484	^{bc}063.542	^{fgh}935.10	^{cde}859.0
	2-KSC647	^{h}34.64	^{ef}21	^{bc}43.16	^{i}703.9	^{def}6.372	^{d}2.283	^{hi}661.7	^{cde}952.0
	3-OSSK502	^{h}06.56	^{ef}24.18	^{cde}38.15	^{i}653.9	^{fg}7.309	^{d}23.271	^{ghi}907.7	^{e}607.0
	4-S.C704	^{gh}69.85	^{cde}65.23	^{ef}52.13	^{gh}08.13	^{efg}349	^{cd}827.425	^{ghi}947.9	^{de}689.0
	5-K3545.6	^{fgh}73.89	^{def}65.22	^{f}82.12	^{fg}65.13	^{efg}2.318	^{cd}323.431	^{efgh}349.12	^{cde}036.1
	6-SC604	^{cdef}8.124	^{cde}65.24	^{f}38.12	^{gh}23.13	^{efg}5.330	^{d}157.307	^{i}493.4	^{de}731.0
	7-SC301	^{h}13.63	^{f}16.16	^{def}01.14	^{i}873.8	^{g}8.248	^{d}167.332	^{ghi}164.9	^{e}491.0
	8-SC540	^{h}08.69	^{ef}56.20	^{bc}76.16	^{h}51.11	^{def}5.374	^{d}33.294	^{hi}825.6	^{e}519.0

* Different letters indicate significant differences at the level of 5%

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