Interactions of Climate and Salinity on Barley *(Hordeum vulgare* L.) Growth

O Ahmed Al-Busaidi[1], Tahei Yamamoto[1] and Yasushi Mori[2]
[1]Arid Land Research Center, Tottori University, 1390 Hamasaka, Tottori 680-0001, Japan
[2]Shimane University, Matsue 690-8504, Japan

ABSTRACT

This study was carried out to determine the effect of saline irrigation (3 and 13 dS m^{-1}) and climate on barley grown on sandy soil. Barley is a salt tolerant crop and its growth was not completely affected by saline irrigation. Variations in climate affected plant growth by affecting evapo-transpiration and salt accumulation in which higher salinity treatment showed significant differences in soil salinity, stress factor and plant parameters compared to the low salinity treatment. Finally, barley can survive and give a good yield if grown under good conditions and management of soil and water even if it is irrigated with highly saline water (13 dS m^{-1}).

Key words: Glasshouse, growth chamber, greenhouse, electrical conductivity, evapo-transpiration.

INTRODUCTION

In agricultural systems, plant productivity is strongly influenced by environmental conditions such as soil salinity and temperature. Moreover saline irrigation and evapo-transpiration are interconnected terms leading to soil salinity. Barley is grown under a wide variety of soil, water and plant growth conditions. The objective of this study was to evaluate the effect of climate and irrigation water qualities on the growth of barley. The interactive effect of those factors on soil salinity was also investigated.

MATERIALS AND ETHODS

Three different pots experiments were carried out at the Arid Land Research Center of Tottori University, Japan. First one was in a glasshouse (Gl. H.) during winter season (February to April 2005). Second one was also in winter season in a growth chamber (Gr. Ch.) with controlled temperature, relative humidity and light intensity (20 ^{o}C, 60% and 80000 LUX respectively). Third one was in a greenhouse (Gr. H.) during summer season (May to June 2005). Barley grains (*Hordium vulgare* L.*)* were sown into plastic pots filled with sandy soil and irrigated with diluted seawater of 3 and 13 dS m^{-1} after 18 days from sowing. Irrigation frequency was every day and in amount depending on ETc. At the end of the experiment, soil salinity and plant parameters were measured.

RESULTS AND DISCUSSIONS

Barely growth usually affected if the ECe is more than 8 dS m^{-1}. It was found that plant growth irrigated by 3 dS m^{-1} and under all conditions was not affected by soil salinity. However the highest value was found in the greenhouse and was 6 dS m^{-1}. For other saline treatment (13 dS m^{-1}) shown in Figure 1. It is clear that soil salinity was above the acceptable level of barely growth (8 dS m^{-1}) except glass house study. Moreover, the reflected stress factor was also accounting for that effect. It seems that plant growth in greenhouse was suffering from high temperature and salt accumulation in the soil due to high evaporation process. Followed by growth chamber, which was suffering from continuous heating and evapo-transpiration. However, a good condition in glasshouse was supporting saline irrigation but if the study was extended for farther time maybe stress coefficient will show a positive value.

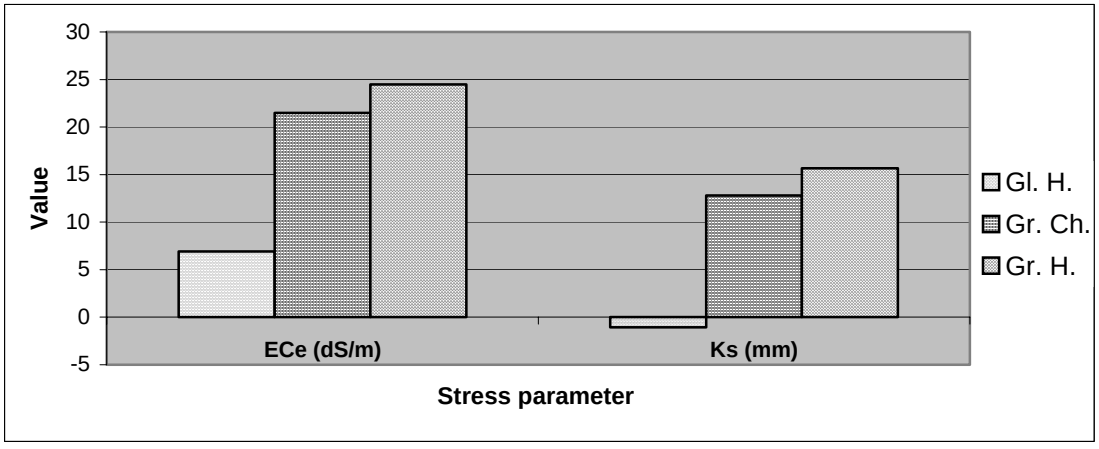

Figure 1: Soil salinity and stress coefficient for 13 dS m^{-1} treatment.

Table 1 shows some growth parameters for all treatments with 5% probability level. It seems that plant growth was significantly ($P < 0.05$) affected by growth conditions and saline irrigation. Treatment with less salinity (3 dS m^{-1}) gave the best results in term of fresh and dry weight. This treatment also enhanced tillering in which the average leaf area was smaller than those of treatment 13 dS m^{-1}.

Table 1 Plant growth parameters

Growth Condition	Salinity (dS m^{-1})	Height (cm)	L. Area (cm^2)	F. Weight (g)	D. Weight (g)
Glass House	3	65.50a	35.76a	401.31a	71.55a
	13	52.17b	26.39b	210.93b	42.75b
Growth Chamber	3	50.33c	31.63c	373.22c	71.87c
	13	40.50d	12.62d	137.58d	33.11d
Green House	3	54.04e	50.26e	353.03e	59.50e
	13	40.02f	36.20f	144.01f	29.50f

* Means within a column for each treatment having that same letter are not significantly different using the 5% Duncan's multiple range test.

Saline water could kill plants if used without proper management. As shown in Figure 2, as soil salinity increase plant cannot survive for long time even if saline water is available. For all conditions irrigated with 13 dS m^{-1}, plants were suffering from water shortage and it was difficult for plant to give a normal growth. Even plants were grown under different conditions but still it was affected by salinity stress.

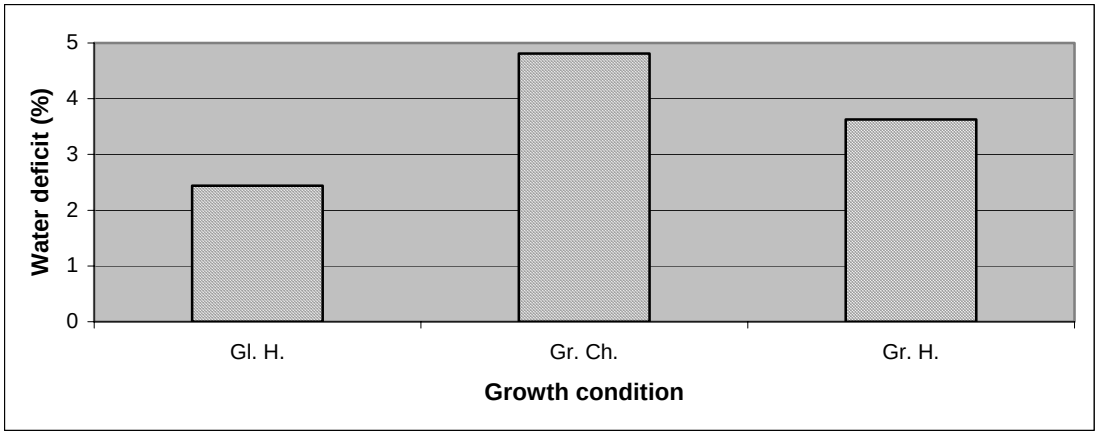

Figure 2: Plant water deficit within each growing condition at 13 dS m^{-1} treatment.

Saline water could kill plants if used without proper management. However, selecting proper conditions with good management of saline irrigation could enable plants to survive longer and give a reasonable yield.

CONCLUSIONS

Results of this study showed that saline irrigation could be applied if it is used with a good management. Barely was growing very well with low salinity (3 dS m^{-1}) but differences in plant parameters were highly affected by variation in growth conditions. Increasing salinity level (13 dS m^{-1}) helped in increasing salt accumulation and suppressing plant growth. Variation in growth conditions could result in differences in plant evapo-transpiration, salt accumulation and plant stress factor. However plant can survive if it is grown under suitable conditions and with a good management even if it is irrigated by saline water.

REFRENCES

Al-Tahir, O.A., Al-Nabulsi, Y.A., Helalia, A.M., 1997. Effects of water quality and frequency of irrigation on growth and yield of barley *(Hordeum Vulgare* L.*)*. Agricultural water management. 34, 17 – 24.

Blanco, F.F., Folegatti, M.V., 2002. Salt accumulation and distribution in a greenhouse soil as affected by salinity of irrigation water and leaching management. Revista brasileira de engenharia agricola e ambiental. 6, 414 – 419.

Koszanski, Z., Karczmarczyk, S., 1985. Use of saline water for irrigation of spring barley and oats. Zeszyty-Naukowi-Akademii-Rolniczej-w-Szczecinie, -Rolnictwo 36, 95 - 105.

Richards, G.A., Pereira, L.S., Raes, D., Smith, M., 1998. Crop evapo-transpiration: guidelines for computer crop water requirements. FAO Irrigation and Drainage Paper 65, pp. 5.

Shalhevert, J., 1994. Using water of marginal quality for crop production: major issues. Agricultural water management. 25, 233 – 269.