PLANT ECOPHYSIOLGY
https://jpep.jiroft.iau.ir
PLANT ECOPHYSIOLGY
Plant Ecophysiology 3(2024) 35-39

Study of tewenty-six genotypes of cultivated barley(Hodeum Vulgare L.) for salinity tolerance by measurement Na^+ and K^+ Cations

Gh.A Mohammadi*[a] , M.R. Bahramjerdi[b]

[a,b] Department of Agronomy, Jiroft Branch ,Islamic Azad University, Jiroft, Iran
E-mail: (corresponding author): gholamabasm@yahoo.com

https://zenodo.org/doi/10.5281/zenodo.10573561

Abstract
Twenty-six genotypes of cultivated barley collected from Iran were compared for salt tolerance. Plants were grown in 2Kg pots and subjected to three salinity(NaCl) treatmentsand (1.2 ,8.9 and 16.7ds/m) in a greenhouse at jiroft. The expriment was done in a factorial with complete randomized design and three replications.During vegetative growth shoot Na^+ ,K+ contents were measured for all genotypes.Plant traits including the plant height ,length of spikes ,number of spikes per plant ,fresh weight and dry matter and grain yield per plant were also measured.There was a very wide variation in salt tolerance of the genotypes with regard to Na^+ and K+ contents.In general tolerant genotypes with better agronomic performance contained lower Na and a higher amount of K to non-tolerant ones and these two parameters were significantly and negatively correlated($r=-0.71, p<0.01$).
Keywords: Barley, Salinity, Plant traits, Grain yield

Introduction

Salinity of agricultural lands and irrigation water is the most limiting factor for plant growth in many dry parts of the word.Twenty five million ha of agricultural land are saline in Iran and this is increasing due to poor irrigation management (FAOSTAT,2014).Barley is a relatively tolerant crop to soil salinity and genetic variations exist among genotypes of cultivated barley(Gray & Stewart,1984). Under water deficit conditions plants may use different mechanisms to alleviate the stress.For example , Kamboje et al.(Kamboj *et al*.,2015) compared different barley genotypes under salinity stress and found that the pathway of abscisic acid is among the most important physiological mechanisms determining barley tolerance under stress. Barley response under water deficit conditions is correlated with changes in plant physiological (Mezer *et al*,2014) and morphological (Haling *et al*., 2014) parameters as different barley genotypes indicate significant differences.Salinity stress is made of osmosic and ionic effects that both can affect on plant metabolism.Stem growth usually more that root growth is affected.(Greenway & Munns, 1980).Mafton and Sepaskhah in studing on wheat cultivars observed that more tolerance salinity in Tabasi cultivar was because fewer aggregation in shoots.(Mafton &Sepaskhah,1989).

There is a general relationship between low Na accumulation and salt tolerance in barley. The amount of K may be correlated with tolerance to salinity (Forster *et al.*,1994).Barley(Hordeum vulgare L.) is an importmant crop plant similar to wheat and rice, which is planted under a wide range of environments ,worldwide ,and as a result can be used as an excellent model for the prediction of crop response to climate change(Jamshidi & Javanmard, 2018). Barley is a great source of food and drink for human, and it is also used for feeding livestock (FAOSTAT,2014). Here we used the shoot Na^+ and K^+ content to screen and different 26 genotypes of cultivated from different parts of Iran. The study was aimed at investigating the genetic variation in salt tolerance and to find the suitable selection for differentiation of genetic variation for the trait.

Materials and methods

Tewenty-six barley genotypes(Hordeum Vulgare L.) collected from different area of Iran were tested for shoot Na and K contents(Table1) .

Table1:number and name of different genotypes.

Row(number of genotype)	The name of genotyp
1	Asse/karoon
2	Torsh/9cr-279-0711
3	Star/Jerusa/em/Rihane-03
4	Zarjow//Rihane/L.640
5	73M47
6	Kavir/Badia
7	Karoon/Kavir
8	80-5010/Mona
9	Zarjow/Hiproly
10	Kavir/Mch-M4
11	Zarjow/Bit//CM67
12	Chat//Roho/Alger
13	Lignees527/NK1272
14	P12315/Maf/02//Cossack/3/Lignee527
15	Rihane s/Deiralla106
16	C1717-9/Deiralla106
17	Black hole with two row
18	Black hole with six rows
19	Six rows barley
20	Hymalia barley
21	Victoria barley
22	Probost dowarf
23	Rihan
24	Walfajre
25	Afzal
26	Walfajre//Apm/Hc

Before planting the seeds of all genotypes were surface sterilized by 2.5% sodium hypochlorite solution for 15 min and rinsed 3 times with distilled water.

All genotypes were planted in a greenhouse in pots containing 2kg of soil.

Experimental Desine And Treatments

A factorial experiment with 2 factors including genotypes and salt treatments(3levels) was conducted in a completely randomized design with 3 replications.Three levels of salinity were 0 ,2500 and 5000 mg of NaCl in oneKg soil.Five germinated seed of each genotype were planted in a 2 kg-pot containing 2kg of soil (sandy-clay-loam :31%clay ,22% silt and 47%sand ,pH=7.4)with moisture saturation of 58%,field capacity of 27% and electric conductivity orEC=0.49ds/m).

The final salinity levels after irrigation were 1.2(control) ,8.9 and 16.7 ds/m.The pots were put in plastic bags to prevent excess water drainage and hence to control salinity level of the pots.Salt(NaCl) was applied by making a saline stock solution of 125 gNaCl.The salt treatments were applied at 4 stages, at one-week intervals.The first application was at 2-leaf stage.For the first level of salinity at each stage ,10 ml of the stock solution and for the second level of salinity ,20 ml of the stock solution were applied into each pot and considering field capacity of the soil ,water was added in adequate amounts while the pots were placed on a balance.

Sampling and Measurements

For measuring Na and K ,4 weeks after the last stages of salt treatment ,shoots of 3 plants of each pot were harvested and oven-dried at a 65C for 48 hr, and then milled to a fine powder.
A 0.5gr sample of milled shoot was put in a crucible.The samples were then ashed by placing in a furnace at 500c for 6 hr.5ml HCL(2N) was added into each crucible and mixed thoroughly.The mixture made up to 50ml with boiling distilled water and filtered in a 50 ml volumetric flask.Na and K concentrations were measured using flame photometry.

Plant morpho-physiological measurements

Individual plant fresh weights(FW) were measured four weeks after salt treatments.At harvest other traits including the dried plant weight(DW) ,plant grain yield(GY) ,plant height(PH) ,spike length of the main tiller ,number of spikes per plant and number of tillers per plant were measured.

Results and Discussion

In general increasing salinity level from 1.2 to 16.7 ds/m caused a significant increase in Na^+ content in all genotypes (Fig1).

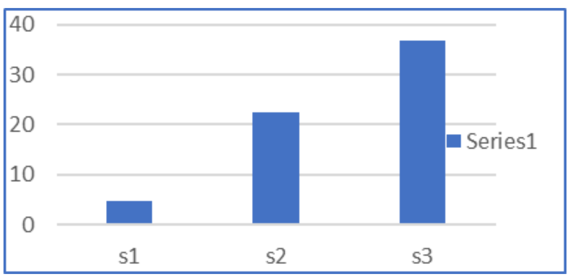

Fig1- Na^+ content according to average of 26 genotypes at 3 levels of salinity(s1=1.2 ,s2=8.9 and s3=16.7 ds/m).

There was a very wide variation between different genotypes with regard to shoot Na content.(Table2).
Genotypes collected from different and same areas showed high variation for Na^+ content.

Table 2- very wide variation between different genotypes

Na content mg/gr	Genotype number	Na content mg/gr	Genotype number
12.32vwx	25	20.32c-p	5
13.3u-x	6	20.5c-o	13
14.79r-x	21	20.8c-o	10
15.9m-v	24	20.8c-n	14
16.86l-u	9	21.00c-m	19
17.03k-u	17	21.7c-m	2
17.7j-u	8	21.7c-m	11
18.6h-t	18	21.85b-j	26
19.5e-r	15	24.0a-f	12
19.6e-r	16	24.2a-e	7
19.85c-q	22	24.3a-d	4
20.3c-q	20	24.7a-c	1

Afzal genotype(cultivar number 25) which is considered a salt tolerant cultivare has a lowest Na content (12.32) and Reyhan(cultivar number 23) which is not a tolerant cultivar for salinity has a high content Na(25.2).ranked among highest Na content and hence the most sensitive genotypes.

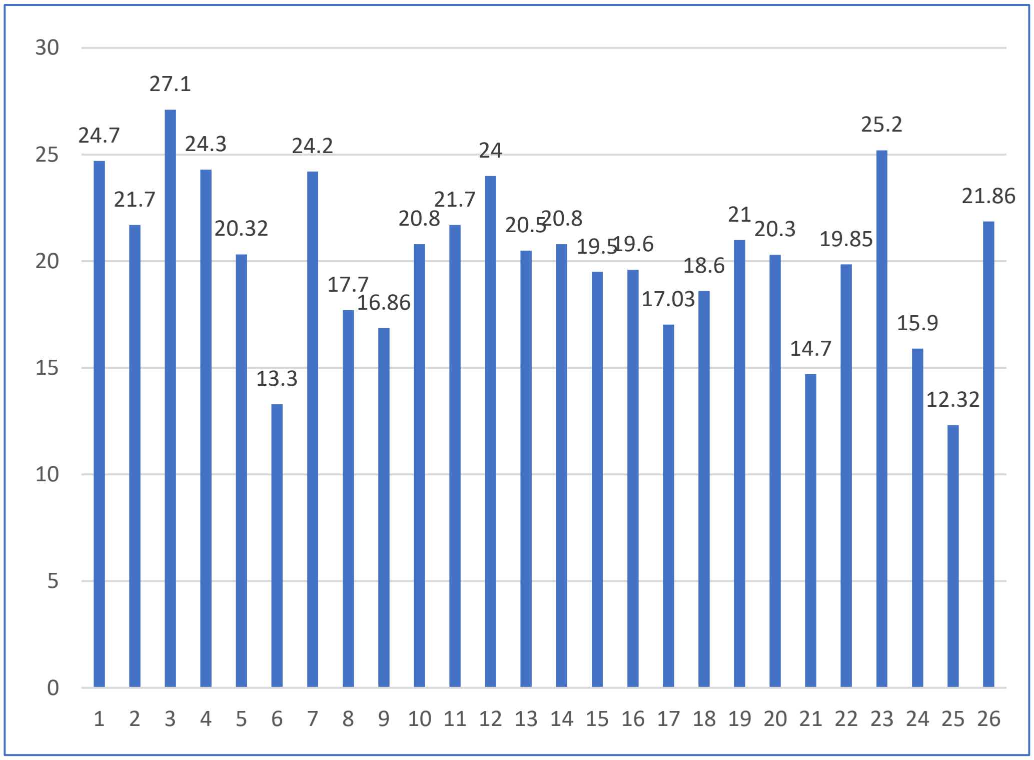

Fig2- Na+ content at s2=8.9 in 26 genotypes.

Table 3-Order of genotypes according to K content

Potassium content mg/gr	Genotype number	Potassium content mg/gr	Genotype number
55.67a	25	36.63f-m	11
45.43b	10	36.43f-m	16
42.22b-e	19	33.34j-r	9
41.89b-f	24	33.33j-r	8
41.86b-f	13	33.31j-r	18
41.17b-h	26	32.47l-r	4
40.89b-h	17	30.78n-t	5
39.63c-i	14	30.63o-u	2
38.68c-j	12	29.51p-v	1
37.76c-m	21	29.01q-v	15
37.64d-m	7	26.57t-w	23
37.17e-m	3	25.63uvw	20
36.64f-m	22	22.48w	6

Salinity Effects on Grain Yield and Yield components of genotypes

Salt stress had adverse effects on grain yield and yield components of all genotypes.Correlation coefficients between different traits of genotypes are in Tabel 4.

These adverse effects were drastic in various cultivated genotypes.There were significant differences among genotypes for grain yield per plant and a significant negative correlation was observed between Na content and grain yield per plant.(Table 4).

Tabel 4- Correlation coefficients between different traits of genotypes.

	Seed yield	Plant height	Dry weight	Na	K
K	0.12ns	0.09ns	0.12ns	-0.71**	1
Na	-0.93*	-0.96**	-0.94**	1	
Dry weight	0.99**	0.94**	1		
Plant height	0.91*	1			
Seed yield	1				

** ,* Significant at 1 and 5% probability levels respectively.

References

Dawson IK. Russell J. Powell W.Steffenson B.Thomas WT. Waugh R. Barley: a translational model for adaptation to climate change.New phytol.2015:206:913-31.

FAOSTAT. Food and Agriculture Organization of the United Nations Statistics Division portal.2014.

Forster, B.P., Pakniat, H. , Macaulay, M., Matheson, M., Phillips, M.S., Thomas, W.T.B. , Powell, W.(1994).Variation in leaf Na content of Hordeum vulgar (barley) cultivar Maythorpe and its derived mutant cv.Golden Promise. Heredity.73:249-253.

Gray, V. , Stewart, C.T.(1984).Steady state Na levels in salt shocked barley leaves. Plant physiol.76:567-570.

Greenway, H., Munns, R.(1980).Mechanisms of salt tolerance in nonhalophytes Ann .Rev. Plant Physiol.31:149-190.

Haling R.E., Brown L.K., Bengough A.G., Valentine T.A. , White P.J., Young I.M., George T.S. (2014). Root hair length and rhizosheath mass depend on soil porosity, strength and water content in barley genotypes. Planta .239:643-51.

Jamshidi .A , Javanmard, H.R.(2018).Evalution of barley (Hordeum vulgare L.) genotypes for salinity tolerance under field conditions using the stress indices.Ain shams Engineering Journal.9:2093-2099.

Kamboj A, Ziemann M. Bhave M.(2015). Identification of salt-tolerant barley varieties by a consolidated physiological and molecular approach. Acta physiol plant. (37):1-12.

Mafton, M., Sepaskhah , A.R.(1989).Relative salt tolerance of eight wheat cultivars. Agrochimica.33:1-14.

Mezer M, Turska-taraska A., Kaczmarek Z.(2014). Differential physiological and molecular response of barley genotypes to water deficit. Plant physiol Biochem.80:234-48.