Response of Different Barley Varieties and Lines Under Saline Environment

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ABSTRACT

A two year study (1985-1986) was conducted at the University of Al-Fateh farm, Tripoli, Libya to investigate the response of different barley (*Hordeum vulgare* L.) varieties and lines under saline environment. The soil types was a loamy sand, plants were irrigated with 25% diluted sea water during the experiment.

Analysis of variance showed significant differences between barley genotypes in number of seeds per head, seed weight, spike length, total plant weight, and plant height. However, the differences between entries of this experiment in grain yield per plant, number of heads per plant, and root weight were not significant. The data also showed a positive correlation between grain yield per plant, and the number of seed per head, and the total plant weight, and a negative correlation between grain yield per plant and the number of heads per plant.

INTRODUCTION

Agronomic crops vary in their tolerance to salts, however yield of most salt tolerant species are reduced when exchangeable sodium percentage exceeds 40-60 (11).

High levels of NaCl reduced the rate of photosynthesis (5). High salinity also resulted in plant mortality, increased leaf necrosis reduced leaf green color, and decreased yield and quality (1). The fresh weight of tops and roots was decreased by increasing NaCl percentage in solution culture (4). Langdale and Thomas (10) reported that the decrease in growth rate by salinity resulted from physiological unavailability of water and/ or from specific ion toxicities. Plants grown in saline environment were shown by Hopkins (8) to be shorter due to a shortening of internodes as a result of smaller cells. Other reports (7) showed that root growth increased with increase in salinity, while the top was decreased.

Barley is one of the most salt-tolerant crops (3). Barley cultivars differ in their tolerance to salinity, with cultivar California Mariout being exceptionally tolerant to high

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levels of salinity (2). It was concluded that success in increasing salt tolerance in a given species depends on its heritable variation and the effectiveness of selection technique (6, 9).

Although salinity can usually be controlled, there is an urgent need to develop more salt tolerant cultivars for use in the irrigated desert regions of the world.

The objective of this study was to compare barley varieties and lines in growth, and yield characteristics and to find whether these characterisitics are interrelated under saline environment.

MATERIALS AND METHODS

A loamy sand soil was prepared for planting and fertilizer in the form of NPK (12: 24: 12) was added at planting, and during tillering at a rate of 200 kg/ha. The replicated experiment was done in the same location in each of two years. The soil was irrigated with 25% diluted sea water during the growth period. Two barley varieties: California Mariout, a local tolerant variety and MISC-37, an introduced salt tolerant variety; and two composite cross lines and MISC-37 variety were received from CIMMYT in Mexico.

The experimental design was a split plot with varieties and lines as main plots, and years as sub-plots. The barley was planted in November at a rate of 60 kg/ ha, and samples of plants were taken from each plot and measured for different characteristics at maturity. All data were analysed using the standard analysis of variance; means were compared using Duncan Multiple Range Test, and simple correlations were made between different characteristics.

RESULTS AND DISCUSSION

Electric conductivity, and salt concentration of the irrigation water and of the soil extract are shown in Table 1, which indicate that salinity in spite of its fluctuation within each year was maintained throughout the experiment as a factor affecting the normal growth of barley plants.

Grain yield per plant data (Table 2) show non significant differences between the varieties and lines. This reflects the complex nature of yield and may be due to a small sample size. Grain yield per plant is positively correlated with total plant weight (Table 4) which suggests that under saline condition selection for total biomass is also effective for grain yield. Grain yield per plant was positively correlated with number of seeds per head and negatively correlated with number of heads per plant. This suggests that selection of plants with fewer heads, and large number of seeds per head would result in increasing yield of this crop.

Table 2 shows non-significant differences in number of heads per plant between varieties and lines. This might be due to the nature of this character. Table 4 shows a negative correlation between number of heads per plant, total plant weight, and root weight suggesting that under saline conditions few carbohydrates go for head formation.

Number of seeds per head data (Table 2) shows significant differences between varieties and lines for this character, which means that there is a possibility of selecting and/ or breeding for increased number of seed per head.

Table 1 — Electrical conductivity, salt concentration of the irrigation water, and soil extract at the beginning and end of the experiment.

Description	Electric conductivity m mos/ cm	Salt Conenctration ppm
Irrigation water	15.45	9888.00
Soil at beginning of experiment	0.27	175.43
Soil at end of experiment	4.85	3102.72

Table 2 — Grain yield components, and grain yield for four barley varieties and lines grown at University of Al-Fateh farm, Tripoli, Libya with saline water in 1985-1986.

Varieties and lines	Head per plant (No.)	Seed per head (No.)	Seed weight (g/ 1000)	Grain yield Per Plant (g)
Misc-37	3.0*	20.8a	35.8b	2.1a
CC XXXII	2.7a	37.6c	42.7ab	3.8a
CC XXVIII	3.0a	22.5ab	46.3a	2.7a
California Mariout	2.9a	26.2b	41.7ab	3.2a

* Means followed by the same letter are not significantly different at 5% level of probability.

Table 4 shows a positive correlation between number of seed per head, total plant weight, and root weight indicating that a good plant growth is associated with good number of seeds per head.

Seed weight data expressed as weight of 1000 seeds (Table 2) indicated that there were differences among barley varieties and lines which means that we can select and/ or breed for salt tolerant plants with respect to this character. Table 4 shows a positive correlation between seed weight and spike length indicating that heavier seeds reside in long spikes which can be used in selecting for heavy seeds.

Table 3 shows significant differences for spike lenght among varieties and lines which means that we can select and/ or breed for varieties or lines that have long spikes and thus will be more productive in a saline environment.

Total plant weight data (Table 3) show significant differences between barley varieties and lines in this character which suggest the possibility of selecting and/ or breeding for higher total plant weight under saline condition. Total plant weight correlate positively with root weight (Table 4). Thus, under saline condition we can select for increased root weight by choosing heavy plants.

Root weight data (Table 3) show no significant differences in this character among barley varieties and lines which is due to the nature of this character.

Finally, plant height data (Table 3) show significant differences between barley varieties and lines. This means that we can select and/ or breed for plant height. From

correlation data (Table 4) tall plants have a tendency to be heavier and produce more seeds per head than short plants.

Table 3 — Average of four characteristics for four barley varieties and lines grown at University of Al-Fateh farm Tripoli, Libya with saline water in 1985-1986.

Varieties and Lines	Spike Length	Total Plant Weight	Root Weight	Plant Height
	(cm)	(g)	(g)	(cm)
Misc-37	3.7a*	8.8ac	1.5a	48.4ab
CCXXXII	4.4ac	14.3b	2.1a	50.6a
CCXXVIII	5.4bc	9.9ac	1.4a	46.5ab
California Mariout	5.4bc	10.4bc	1.2a	42.8b

* Means followed by the same letter are not significantly different at 5% level of probability.

Table 4 — Correlations between different characteristics for four barley varieties and lines grown at University of Al-Fateh farm, Tripoli, Libya with saline water in 1985-1986.

Character	Total Plant Weight	Grain Yield	Spike Length	Root Weight	Plant Height
Grain yield	0.92	X	0.33	0.55	0.13
Heads per plant	−0.94	−0.91	0.09	−0.79	−0.45
Seeds per head	0.99**	0.93	−0.04	0.81	0.47
Seed Weight	0.36	0.50	0.81	0.03	−0.16
Total Plant Weight	X	0.92	0.01	0.83	0.50

* Significant at 5%
** Significant at 1% level of probability.

CONCLUSION

The mean separation data show significant differences between barley varieties and lines in such characters as number of seeds per head, seed weight, spike length, total plant weight and plant height which permits selection and/ or breeding for salt tolerant barley in these characteristics. There were non-significant differences in such characters as grain yield, number of heads per plant, and root weight, which might be due to the nature of these characters or might be due to small sample size.

There was a positive correlation between grain yield per plant and number of seed per head, and a negative correlation with the number of heads per plant indicating that in order to select and/ or breed for yield we should look for many seeds per head and less number of heads per plant. Grain yield also correlates positively with total plant weight, thus it is possible to have a barley plant good for both total biomass and grain production under saline condition.

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استجابة أصناف وسلالات الشعير للبيئة المالحة

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المستخلص

أجريت دراسة في سنتي 1985، 1986 بمزرعة جامعة الفاتح بطرابلس/ الجماهيرية لتحري استجابة أصناف وسلالات من الشعير للبيئة المالحة، وكان نوع التربة طينيًا رمليًا حيث رويت النباتات طيلة التجربة بماء بحر تركيز الملوحة فيه 25%. تحليل التباين أوضح اختلافات معنوية بين الأنماط الوراثية للشعير في عدد الحبوب في السنبلة ووزن الحبوب وطول السنبلة والوزن الكلي للنبات وطول النبات. ولكن الاختلافات بين محتويات التجربة في إنتاجية الحبوب في النبات الواحد وفي عدد السنابل في النبات وفي وزن الجذور كانت غير معنوية. بيانات التجربة أظهرت أيضاً ترابطاً إحصائياً موجباً بين إنتاجية الحبوب في النبات وكل من عدد الحبوب في السنبلة والوزن الكلي للنبات، وأظهرت ترابطاً إحصائياً سالباً بين إنتاجية الحبوب في النبات وعدد السنابل في النبات.