**Journal of Global Agriculture and Ecology**

13(2): 26-50, 2022
*ISSN: 2454-4205*

# THE INFLUENCE OF THE SALINITY AND WEED CONTROL TREATMENTS ON SOME BARLEY CULTIVARS AND ITS ASSOCIATED WEEDS

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**AUTHORS' CONTRIBUTIONS**

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

***Received: 25 December 2021***
***Accepted: 28 February 2022***
***Published: 10 March 2022***

***Original Research Article***

## ABSTRACT

In Egypt barley cultivated in new and outlying lands, its yield and quality affected by salinity as abiotic and weeds as biotic stresses which constraints to barley production. Two lysimeter experiments were conducted during seasons 2019/2020 and 2020/2021 winter seasons. In the present work, studied four saline water levels (2.33,4,8 and 12dSm$^{-1}$) to distinguish the salinity stress tolerance among four of Egyptian barley cultivars (Giza 123, Giza 132, Giza 137 and Giza 138), in addition to find a suitable weed control treatments under salinity stress using three factors in completely randomized design (CRD) with three replications The main findings illustrated that four SSR primers (Bmac 0040, EBmac0871, Bmag 135 and Bmag 770) were generated clear patterns with the high polymorphism (100%); and enable plant breeders to select individual plants based on their marker pattern (genotype) rather than their observable traits (phenotype). Using Bmag 770, amplified specific allele with molecular size 260 bp found in the salt tolerance cultivars (Giza 123 and Giza 137) as a tolerant to salinity. Each of the three studied factors (salinity, weed stress and weed control treatments) individually and their interactions had a significant effect on weed populations and on barley yield economically. The interaction among the factors of the trial and the recommended of the two herbicides (bromoxynil octanoate at 1 L fed$^{-1}$) +( clodinafop propargyl 2.5% + Pinoxaden 2.5%) at 0. 5 L fed$^{-1}$) gave the highest means of the characters studied and economic criteria. Therefore, these interactions could be recommended in barley farms to achieve reduction in weed growth under saline conditions and harmful effect of them and boosting barley plantations productivity as well. Economic criteria display that Giza 137 is a good choice cultivar for salinity soil because of its high weed tolerance ability (WTA) and Giza 123 good cultivar for grown in salinity soil but it poor WAT so advised to using by herbicides as weed management to reduce weeds population and increase yield toward increasing farmer's income under salinity soil area.

**Keywords:** Hordeum vulgar, salt stress, weed interference, herbicide, bromoxynil octanoate, clodinafop propargyl + Pinoxaden SSR and multivariable analysis.

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## 1. INTRODUCTION

Agricultural yields in the world has been a challenge due threatened by various biotic and abiotic stresses losses about 13–94% yield worldwide, which abiotic stress compulsory on plants by environment, while as biotic stress exposed as a biological component [1]. Salinity stress is a significant abiotic stress that affect adversely on crop production, influencing the metabolic activities and causing plant injures which are controlled by a large number of genes which make them subtle to selection for tolerant breeding programs [2]. Furthermore, salinity affected areas probable will be increased further around 50% of the world's total arable land by 2050 [3]. In Egypt, soil salinization region were found on about 60% of the cultivated lands of Northern Delta region, 20% of Southern Delta and middle region and 25% of Upper Egypt regions [4].

Weed interfering is one of the greatest biotic controlling factors causing maximum decreasing crops production, than pests or diseases. Yield reduction caused by weeds is directly related to the number of weeds present in the crop and in certain areas of the province, which they strive with crop plants for light, water and nutrients, hence, the weeds stress could cause up to 66% decreasing yield [5,6].

Barley (*Hordeum vulgare L.*) is a cereal crop that is grown in most countries; it is ranked as fourth in world crop production which is used for animal feed, malts and human food, which it is the most important source of carbohydrates and protein for animal and humans, globally it is attacked by many biotic and abiotic stresses, which caused reduced and damages in yield and its quality [7]. It's considered a model crop for salinity tolerant in cereals due to its widely available genetic information [8]. However, weeds are a major constraint to achieving high yields in barley; it not only reduces the yield of barley crops, but can also deteriorate the quality of malting [9].

Thus, the breeders put high effort in reducing yield losses due to abiotic and biotic stresses. The first line of defense in plants against environment stress is plant resistance or tolerant which these plants includes the inherited ability of defend itself. Second line is inducing defense mechanisms through using control management methods. DNA markers have been proved to be valuable tools used in evaluation of genetic diversity which not commonly affected by environment, selection, and are available in almost unlimited numbers [10]. Microsatellites or Simple sequence repeats (SSRs) is molecular marker techniques, have high polymorphism rate, co-dominant inheritance, highly reproducibility, locus specificity and random distribution on the genome [11]. Furthermore, SSRs are influential markers which are outstanding for assessment of genetic diversity and crop enhancement for abiotic stress tolerance [12-14].

Integrated weed management (IWM) programs were the most essential cultural practices which using to reducing weeds in order to increasing the yield and quality of crops. There were many IWM programs were used in weed control, hand weeding treatment is the most widespread method of weed control, resulting in good control of weeds but this way is labors and pay rise [15]. Chemical treatments using (Herbicide) reduce weed plants number and inhibits their growth this help plants to grow up naturally without the risky competition with weeds through getting the effective photosynthetic and the other bio-activities process [16] nevertheless there is a great need to select suitable herbicides and determine the effective minimum dose of the herbicides for controlling weeds [17] and weed competitive genotypes is one of IWM practices which it represent an effective strategy for decreasing the damage of weed without using herbicides, however, information on the weed competitiveness of barley is limited [18].

The information about the response of crops and weed competition under saline conditions is essential to safeguard food security under changing climate. Therefore, the salt tolerant genotypes should be followed by effective and appropriate weed control practices for controlling salt tolerant weeds in saline area, to avoid unacceptable yield loss [19].

Nevertheless there are limited research on barley competitive weeds and weed control under saline environment. Thus, the current study aims to screening barley cultivars with SSRs markers for salt tolerance in order to study the effectiveness of weed control management under irrigation by different salinity levels on barley yield and its associated weeds, to use these cultivars in barley breeding programs for salinity soils in Egypt as valuable cultivars for IWM tool for farmers and extension personnel [20].

## 2. MATERIALS AND METHODS

### 2.1 Barley Cultivars

Four barley cultivars (Giza 123, Giza 132, as old cultivars and Giza 137 and Giza 138 as new cultivars), were gotten from the Barley Research Department, Field Crop Research Institute, Agriculture Research center Giza Egypt (Table1). The cultivars were chosen based on their pedigrees, origin normal distribution and their yielding abilities

**Table 1. Name of the four barley cultivars and their pedigree, released year and reference which used in the studied experiment**

| Barley Cultivars | Description of agro-morphological characters | Pedigree | Released year and reference |
|---|---|---|---|
| Giza 123 | Six rows, Egyptian barley variety, early heading, moderated height, high yield ability, precocious, moderately productive in the favorable conditions and tolerant to salinity and fungi diseases. | Giza 117 /FAO86). | Ahmed et al. [21] |
| Giza 132 | Six rows, Egyptian barley variety, late heading, short height, tolerant to drought and fungi diseases, sensitive to salinity. | Rihane-05//AS 46/Aths*2Athe/ Lignee 686) | Noaman et al. [22] |
| Giza 137 | Six rows, Egyptian barley variety, early heading, tallest height, high yield ability precocious, high productive, newly reclaimed and moderate resistance to fungi diseases. | Giza 118 /4/Rhn-03/3/Mr25-//Att//Mari/Aths*3-02) | Amer et al. [23] |
| Giza 138 | Six rows, Egyptian barley variety early heading, tallest height, precocious, high yield ability high productive in newly reclaimed and moderated tolerance to salinity and moderate resistance fungi diseases. | Acsad1164/3/Mari/Aths*2//M-Att-73 337-1/5/Aths/ lignee686 /3/Deir Alla 106//Sv.Asa/ Attik/4/Cen/Bglo ."S" | Amer et al. [23] |

## 2.2 The Lysimeter Experimental Site

Two lysimeter experiments were carried out during two growing winter seasons 2019/2020 and 2020/2021, at Soil improvement and conservation, Research Department at Sakha Agricultural Research station, Karfer El-Sheikh Governorate, which lies in 134 north Cairo, Egypt (31° 06' 25.20" N 30° 56' 26.99" E) to evaluate the potential of four saline water irrigation, three weed control treatments and their interaction on agronomical traits of barley cultivars and their association weeds under salinity stress.

## 2.3 The Lysimeter Experimental Design

The lysimeter experimental design was conducted using three factors in completely randomized design (CRD) with three replications. First factor included four saline water levels for irrigation by mixture the well water (2.33 $dSm^{-1}$) with seawater (45.1 $dSm^{-1}$) according to Ayers et al (1952) to get the require levels , S1 (EC=2.33 $dSm^{-1}$ equal 1491.2 ppm ( as a control ), S2 (EC= 4$dSm^{-1}$ equal 2560 ppm), S3 ( EC=8$dSm^{-1}$ equal 6400 ppm) and S4 (EC=12$dSm^{-1}$ equal 9600 ppm).

Second factor included four barley cultivars (Table 1), were grown at 22$^{th}$ and 25$^{th}$ Nov. 2019 and 2020 respectively, and harvested on 28$^{th}$ and 30$^{th}$ April 2020 and 2021 respectively. All local recommendation was uniformly followed to grow barley plants without any stress expects irrigation treatments.

Third factor consisted of three weed control treatments, (control was unweeded, hand weeding twice at 20 and 35 days after sowing, and herbicides contain (Brominal W 24 % EC (bromoxynil octanoate), was applied at 1 L $fed^{-1}$ at 25 days after sowing to control broad-leaved weeds + Traksos 5% EC (clodinafop propargyl 2.5% + Pinoxaden 2.5%) was applied 500 $cm^3$ $fed^{-1}$ at 35 days after sowing to control grassy weeds) The Knapsack sprayer CP3 was used with water volume of 200 litter water per fed. ) (**Table 2**). Each experiment included 144 and its unit was 1$m^2$ $plot^{-1}$.

The soil samples were collected from all experimental plots before the beginning of the present work and end the harvesting of the two seasons. Each sample was taken in the three consecutive depths at 0-20, 20-40 and 40-60 cm. The reconfirmation of desired salinity levels was done by measuring EC meter (model: Z865/SCHOTT Instruments, Hattenbergstrße 10·55122 Mainz, Germany). Physical and chemical characteristics of the soil samples were shown in Table (3) and the chemical properties of the different saline water irrigations levels were shown in Table (4).

## 2.4 Studied Parameters

### 2.4.1 Agronomical parameters

Plant height (PH), number of grains per spike ($NGS^{-1}$), number of tillers per $m^2$ (NT $m^2$) and grain yield (GY g $plot^{-1}$), from each plot were determine at harvest stage.

**Table 2. Trade, common, chemical names, chemical group, mode of action, herbicide rate/fed and time, beside hand weeding and unweeded control**

| No | Trade name | Common Name | Chemical Group | Chemical name | Mode of Action | Rate L $fed^{-1}$ | Time of application | PH I* | WHO Toxicity classification |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Brominal W 24 % EC | Bromoxynil octanoate | Nitrile | 3,5-dibromo-4-hydroxybenzonitrile | Inhibition Photosystems II | 1 | after 25 days sowing | - | Mod II |
| | Traksos 5% EC | Clodinafop propargyl 2.5% + Pinoxaden 2.5% | Aryloxphenoxy propionate + Phenylpyrazolie | propynyl (*R*)-2-[4-[(5-chloro-3-fluoro-2-pyridinyl)oxy] phenoxy] propanoate + 8-(2,6-diethyl-4-methylphenyl)-1,2,4,5-tetrahydro-7-oxo-7*H*-pyrazolo[1,2-*d*][1,4,5]oxadiazepin-9-yl 2,2-dimethylpropanoate | Inhibition Lipid synthesis and ACCase (acetyle CoA carboxlyase) | 0.5 | after 35 days sowing | 60 | Low III |
| 2 | Hand weeding twice | carried out at 20 and 35 days after sowing (DAS) | | | | | | | |
| 3 | Control | Un-weeded | | | | | | | |

- ***PH I****Preharvest Interval*

**Table 3. The mean values of soil moisture characteristics, some Physical and chemical properties of experimental soil**

| Soil properties | Characteristics | Soil depth(cm) | | | |
|---|---|---|---|---|---|
| | | 0-20 | 20-40 | 40-60 | mean |
| Soil moisture characteristics | W.p* | 22.11 | 21.50 | 20.16 | 21.26 |
| | F.C* | 42.85 | 40.57 | 38.75 | 40.72 |
| | A.w* | 20.47 | 19.07 | 18.59 | 19.47 |
| Chemical properties | pH* | 7.86 | 7.92 | 8.18 | - |
| | ECe (dSm-$^1$) * | 3.42 | 3.78 | 4.65 | 3.95 |
| | SAR* | 10.20 | 10.63 | 11.8 | 10.87 |
| Soluble cations meq100 $^1$ g soil | $Ca^{++}$ | 7.21 | 8.00 | 11.34 | 8.85 |
| | $Mg^{++}$ | 4.20 | 4.72 | 6.63 | 5.18 |
| | $Na^{++}$ | 24.38 | 26.80 | 35.60 | 28.95 |
| | $K^+$ | 0.60 | 0.71 | 0.91 | 0.74 |
| Soluble anions meq100$^{-1}$ g soil | $SO_4$ | 15.9 | 17.73 | 23.63 | 19.10 |
| | $Cl^-$ | 18.95 | 20.5 | 27.85 | 22.43 |
| | $HCO_3$ | 1.50 | 2.00 | 3.00 | 2.17 |
| | $CO_3$ | ------ | ------- | ------- | ------- |
| Physical properties | Texture grade | clay | Clay | Clay | |
| | Bulk density (kg/cm3) | 1.26 | 1.31 | 1.36 | 1.31 |
| Particle size distribution (%) | Clay | 51.80 | 52.33 | 52.57 | 52.23 |
| | Silt | 32.25 | 32.92 | 33.45 | 32.87 |
| | Sand | 15.95 | 14.75 | 13.98 | 14.90 |

**W.P.: wilting point, F.c: field capacity, A.W: Available water; PH : was determined in soil water suspension (1:2.5) EC: was determined in saturated soil paste extract SAR: sodium adsorption ratio*

**Table 4. Chemical properties of the four water irrigations used in the locations in the two experiments**

| Salinity levels | PH | EC dSm$^{-1}$ | SAR* | Soluble cations meq100 $^1$ g soil | | | | Soluble anions meq100$^{-1}$ g soil | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $Na^+$ | $K^+$ | $Ca^{++}$ | $Mg^{++}$ | $CO_3^{2-}$ | $HCO_3^-$ | $Cl^-$ | $SO_4^{--}$ |
| S1= 2.33 dSm$^{-1}$ | 7.96 | 2.33 | 8.04 | 15.8 | 0.6 | 4.92 | 2.81 | - | 2.0 | 12.5 | 9.63 |
| S2=4 dSm$^{-1}$ | 8.12 | 4.0 | 11.04 | 29.5 | 0.8 | 9.43 | 4.85 | - | 3.5 | 22.5 | 19.59 |
| S3=8 dSm$^{-1}$ | 8.23 | 8.0 | 17.98 | 61.62 | 1.5 | 12.81 | 10.67 | - | 6.5 | 43.1 | 37.03 |
| S4= 12 dSm$^{-1}$ | 8.27 | 12.0 | 19.43 | 88.65 | 2.5 | 26.20 | 13.43 | - | 10.5 | 65.14 | 57.14 |

**SodiumAbsorpation Ratio*

***Stress susceptibility index( SSI)***: was calculated on the basis of grain yield of four barley cultivars over the two growing seasons to select the favorable cultivars with suitable yield under different salinity stress conditions according to **[24]** and equation

$$(SSI) = (1 – Ys/Yp) / (1 – \bar{Y}s/\bar{Y}p).$$

Where: Ys and Yp are the yields of genotypes evaluated under (stress) and (non-stress) conditions and $\bar{Y}$s and $\bar{Y}$p are the mean yields of all varieties evaluated under stress and non-stress conditions, respectively**.**

### 2.4.2 Weed characters

The number of weeds presented in m$^2$ in a permanently marked sampling area was counted at 45 and 65 after days sowing in each treatment then identified into species and classified into the two groups of narrow-leaved and broad-leaved weeds. The density of weed population were calculated according to [25] and equation.

$$Density = \frac{No.of\ single\ weed\ species}{No.of\ total\ weeds\ species} x\ 100$$

Dry weight of weeds (gm$^2$) in a permanently marked sampling area was taken as fresh weight then dried at 70 ºC for 72 hours.

Weed control efficiency (WCE %): It denotes the magnitude of weed reduction due to weed control treatment. It was worked out by using the formula suggested by **Mani et al. [26]** and expressed in modal

$$WCE\ \% = \frac{A - B}{A} X100$$

WCE %: Weed control efficiency (WCE %), A: Dry weight of weeds in unweeded control and B: Dry weight of weeds in treatment

## 2.5 Molecular Markers

Genomic DNA of the fresh leaf four barley cultivars was extracted from young leaves using CTAB method, according to Doyle and Doyle [27]. DNA concentration and purity were measured at absorbance ratio of A260/A280 using Nanodrop (ND-1000, Spectrophotometer).

Polymerase chain reaction (PCR) amplification was prepared in volume of 25 µl using approximately 40 ng of genomic DNA, 2 µmol dNTP., 25 mM of $MgCl_2$, 10 pmol of each primer (forward and reverse), a 0.5 µl of 5U of *Taq* polymerase and 12 µl of 10X PCR buffer. PCR cycling was carried out as the following program; one cycle at 95C for 5 min., then 35 cycles was performed as follow: 1 min. at 95C for denaturation, 45 sec. 45-55C for annealing based on primer and 30 sec. at 72C for extension, and then incubated at 72C for 7 min. Seven SSR primers from the published sequences of [28] were selected based on their linkage with particular salinity tolerance genes have been used for this study. Genotype markers were assigned using the Grain Genes Data Base. Amplified products were separated using agarose gel electrophoresis (2%) in 0.5 x TBE buffer against 100 bp DNA Ladder as a size marker**.**

## 2.6 Multivariable Analysis

Simple correlation coefficients were computed among seed weight plant$^{-1}$ and its components [29]. GGE-biplot analyses were analyzed to study the interaction between the genotype and environment using principal components analysis [30]. Economic analyses were performed to estimate returns and prefect using the following formula according to Steel and Torrie [31] and Cimmyt [32].

## 2.7 Statistical Analysis

Phenotypic data were analyzed statistically following completely randomized design using (ANOVA) procedure in SPSS statistical software (version 23). The two experimental are frequently combined in order to estimate an experimental error for the pooled data. Homogeneity test of variances [33] was used before stating the combined analysis. The differences of treatments means were compared by LSD test as given by to Steel and Torrie [34]. All comparisons were done at 5.0 and 1.0 levels of significance.

Amplification of SSR profiles for test barley cultivars were compared with each other and DNA fragments were scored as a binary data. Each fragment was scored as present (1) or absent (0), and pairwise comparisons between individuals were made to calculate the Jukes-Cantor coefficient using PAST program (Paleontological Statistics Version 1.94b) adapted by Hammer *et al.* [35] Cluster analysis was performed to produce a dendrogram using un-weighted pair-group method with arithmetical average (UPGMA).The polymorphism information content (PIC) value is often used to measure the in formativeness of a genetic marker for linkage was calculated according to the method of Anderson [36].

# 3. RESULTS

## 3.1 Changes Due to Different Irrigations Saline Water

### 3.1.1 Changes on the agronomical traits

The analysis of combined data in Table 5, showing that the salinity levels, cultivars significantly influence on plant height (PH), No. grain spike$^{-1}$ (NGS$^{-1}$) and No. tillers m$^2$ (NT) and grain yield (GY). Highly interaction significant was found between cultivars and salinity on all agronomical traits.

Increasing of saline water irrigations from 4 to 12 dSm-1 caused a significant decreasing in plant height PH, no. of grain spike $^{-1}$ (NGS), No. of tillers m$^{-2}$ (NT) and grain yield as showed in (Table 5 & Fig. 1 ), with average reduction with (8.4, 22.5 and 29.5%), ( 5.7, 28.0 and 41.4%), ( 10.2 , 26.9 and 47.1 % ) and (6.5, 25.9 and 55.5%) under 4, 8, and 12dSm$^{-1}$ as compared with 2.33 ds m-1, respectively.

### 3.1.2 Changes on the barley cultivars

About the effect of salinity on all cultivars, the results in (Table 5 and Fig. 2) showed that Giza 137 and Giza 123 had high mean values with low reduction for PH, NGS, NT and GY traits. Giza 138 had moderated mean values, while, Giza 132 had lowest values for all studied traits with high reduction under different irrigation saline water of all studied traits under salinity level 12 dSm$^{-1}$ as compare by salinity level 2.33 dSm$^{-1}$.

Stress susceptibility index( SSI) was calculated on the basis of grain yield under 2.33, 4, 8, 12 dSm$^{-1}$ irrigated salinity levels of four barley cultivars over the two growing seasons was used for selecting the favorable cultivars with suitable yield under different salinity stress conditions, Low SSI index were found Giza 137 were ( 0.900, 0.933 and 0.965) and Giza 123 were ( 0.923, 0.955 and 0.969 ) .Moderated SSI index was n found in Giza 138 with values ( 0.948, 0.956 and 0.999). High SSI index were found in Giza 1132 with values (0.989, 1.023 and 1.276) under 4, 8, 12dSm$^{-1}$ irrigated salinity levels respectively.

**Table 5. Effects of salinity levels and weed control treatments on yield and its related traits and total phenol content (Combined data of two seasons)**

| Treatments / Parameters | Plant Height PH (cm) | No. grain Spike $^{-1}$ NGS | No. tillers $m^2$ NT | Grain Yield GY(gplot$^{-1}$) |
|---|---|---|---|---|
| **Saline levels ( dSm-$^1$)** (S) | | | | |
| 2.33 | 97.5 a | 87.5 a | 293.6 a | 463.4a |
| 4 | 89.3 b | 82.5 b | 263.6 b | 433.1b |
| 8 | 75.6 c | 63.0 c | 214.6 c | 343.6c |
| 12 | 68.7 d | 51.3 d | 155.4d | 206.4d |
| Cultivars (C) | | | | |
| Giza 123 | 77.9 c | 72.3 b | 207.9 c | 399.7a |
| Giza 132 | 68.7 d | 65.3 c | 201.6 c | 275.2c |
| Giza 137 | 95.9 a | 76.2 a | 272.1 a | 416.3a |
| Giza 138 | 89.3 b | 70.5 b | 245.6 b | 365.6d |
| **Weed control treatments (T)** | | | | |
| *Brominal + Traksos* | 89.3 a | 82.3a | 268.9 a | 431.5a |
| *Hand weeding (twice)* | 86.2 b | 76.3 b | 249.2 a | 393.6b |
| *Unweeded control* | 73.4 c | 54.8 c | 177.4 b | 260.3c |
| **Analysis of variance (F .test)** | | | | |
| Saline (S) | * | * | * | ** |
| Cultivars (C) | * | * | * | * |
| Weed control treatments (T) | * | ** | ** | ** |
| **Interaction** | | | | |
| S X C | * | * | * | ** |
| S X T | * | * | * | * |
| C X T | **NS** | **NS** | * | * |
| S X C X T | **NS** | **NS** | * | * |

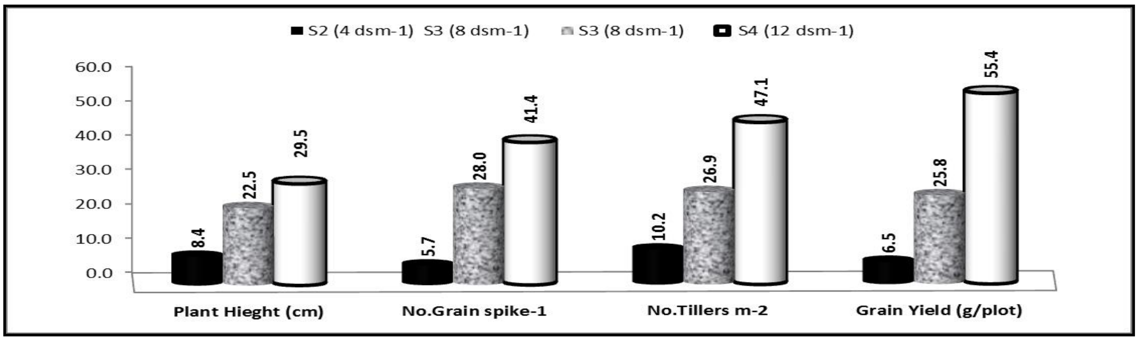


**Fig. 1. The average reduction percentage of the studied traits due to salinity stress 4, 8and 12 dSm$^{-1}$ salinity levels as compere by 2.33 dSm$^{-1}$ level**

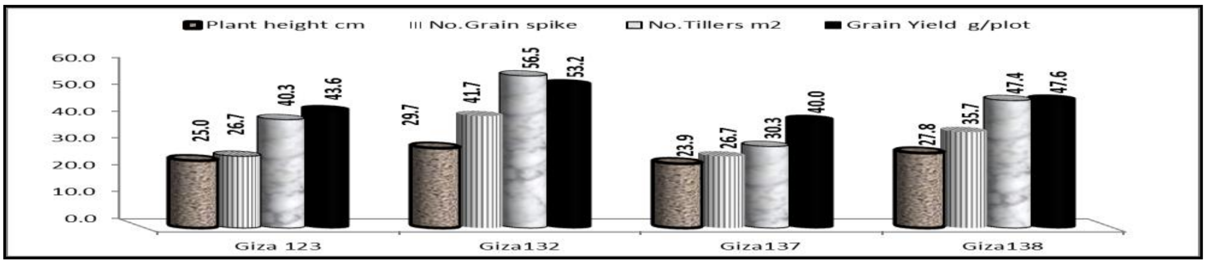


**Fig. 2. The average reduction percentage among the barley cultivars for all studied traits under 12 dSm$^{-1}$ salinity level as compere by2.33 dSm$^{-1}$**

### 3.1.3 Reaction of SSR markers on barley cultivars due to salinity

The present study, molecular markers were to screen four barley cultivars Giza 123, Giza132, Giza137 and Giza138 for their tolerance against four salt levels as 2.35, 4, 8 and 12 $dSm^{-1}$. Furthermore to choice a subtitle method for controlling the weeds species associated barley fields .The polymorphism level of the studied seven SSR primer pairs was shown in (Table 6 & Fig. 3). Three primers showed monomorphic fragment profiles (GBM1459, GBM 1221 and Bmac 0113) and four primer pairs (Bmac 0040, EBmac0871, Bmag 135 and Bmag 770) as generated clear fragment patterns with high polymorphism (100%) which were used to evaluate the genetic diversity and association with salt tolerance of the four barley cultivars. The total fragments of used SSR primer were 12 bands; the band number for each primer was ranged from one to three bands with an average (1.71%) per primer.

The SSR primer (Bmag 770, 1H) generate the highest number with three bands and highest PIC value was (0.85) which amplified specific allele with molecular size 260 bp found in the tolerance cultivars (Giza 123 and Giza 137) and was absent in Giza 132 and Giza 138 as a positive marker for salt tolerance as shown in (Fig. 3A). About, (Bmac 0040, 4H) was a negative marker which has a specific fragment with molecular size 240 bp found only in sensitive cultivar (Giza 132) as shown in (Fig. 3B) with (100%) polymorphism and PIC was (0.73). Regarding, (EBmac 00871, 3H) as shown in (Fig. 3C), showed two fragments generated to be related to salt tolerant found in Giza 123 and 137 and other band found in Giza 132and Giza 138 with lowest PIC was 0.51. However, (Bmac 0135, 7H) as shown in (Fig. 3D), had one band generated to be related to salt tolerant found in Giza 123, Giza 137 and Giza 138 but found in Giza 132.

Dendrogram (Fig. 4) showed that all studied cultivars were clearly grouped into two clusters. The first cluster had only one cultivar Giza 132 as a sensitive cultivar and the second cluster divided into two sub clusters, the first one consisted of the tolerant cultivars (Giza 123 Giza 137) with highest genetic similarity coefficient was (80%) and the second includes Giza 138 which could be moderate tolerance, and lowest genetic similarity coefficient was (40%) between Giza 123 and Giza 132

### 3.1.4 Changes in weed species due salinity

In Table 7 showed that the number of weed species presented in unweeded control plots of the four barley cultivars at 45 days for sowing in the average in the two seasons. Four annual broad-leaved weeds *Chenopodium murale* L., was presented the very density (33.5%), followed by *Chenopodium album* L., *Beta vulgaris* L. and *Silybum marianum* L., and were presented density (11.5, 10.5 and 12.4%), respectively. *Malva parviflora* L. was presented medium density (7.7%), while, (*Sonchus oleraceus* L., *Medicago polymorpha* L. and *Rumex dentatus* L.,) were presented in low density (3.8, 3.3 and 2.2%) , and *Anagallis arvensis* L) get the lowest density was (1%). For the number of annual narrow-leaved weeds, *Phalaris minor* L., was presented in very density (14.1%). Noticed, the most principal weeds in both seasons under salinity levels were (*Chenopodium murale* L.) as annual broad-leaved weeds and (*Phalaris minor* L.) as narrow-leaved weeds continued throughout the season and the rest of weed were disappeared at 55 days after sowing in both seasons.

Results in Table (8) showed that the highest salinity level at12 $dsm^{-1}$ caused a string stress in the presented weeds spices, leaded directly to their greatest reduction. The following reduction on weeds population was obtained under the lowest salinity level at 2.33 $dsm^{-1}$, it may be due to the good growth of barley plants. Happened to weak the presented weeds that is true in the two weed surveys in the seasons together. In first survey at 45 DAS, the significant reduction on the number and dry weight of *Phalaris minor* L. under salinity levels at 2.33, 4 and 12 were (69.7, 26.9 and 82.6%) and (90, 16.9 and 90.3%), respectively, compared to salinity level at 8 $dsm^{-1}$, and in the second survey at 65 DAS, were 80.4, 59.6 and 84.0 %) and (87.1, 3.8 and 90.9%), respectively, compared to salinity control. On the other hand, in first survey, the significant reduction of the number and dry weight of broad-leaved weeds under salinity levels at 2.33, 4 and 12 $dsm^{-1}$, were (22.30, 4.27 and 40.00%) and (35.1, 36.4 and 42.4%), and in the second survey at 65 DAS, were (42.8, 4.5 and 49.4%) and (61.3, 34.4 and 68.7%), respectively, compared to salinity control. The results obtained in the total the pervious weed species conform to a great extant these observed in the first and second weeds surveys as shown in Table (8) & Fig. (5).

## 3.2 Changes Due Weed Interference

### 3.2.1 Changes in agronomical traits

Weeds interference significantly decreased all of agronomic traits with average values were (73.4 cm for PH ), (54.6 grain for NGS) , (177.4 tillers for NT) and (260.3 g $plot^{-1}$ for GY) as showed in Table 5. There were highly significant reduction were recorded in all agronomic studied traits due to the interaction between weeds interference and salinity stress, the reduction in grain yield were (10.0, 35.9 and 74.5 %) under irrigation levels of 4, 8, 12 $dSm^{-1}$ respectively. The results indicated that weeds interference contributed in decreasing all the agronomic traits by (10.5, 16.9, 17.9 and 19.1 %) reduction for PH, NGS, NT and GY under high salinity levels12 $dSm^{-1}$ as shown in Fig. 6.

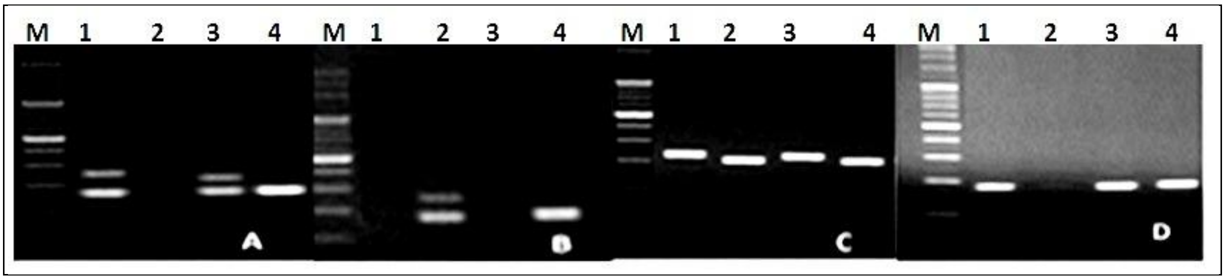


**Fig. 3. Banding pattern using A: Bmag 770 ,B: Bmac 0040 , C: EBmac 00871 , and D: Bmac 0135 SSR primers for four barley cultivars, M: DNA Marker**

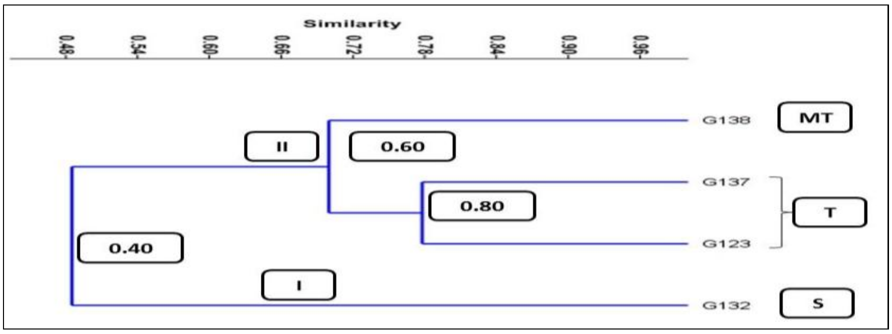


**Fig. 4. Similarity dendrogram of four cultivars based on band polymorphisms generated by seven SSR primers**

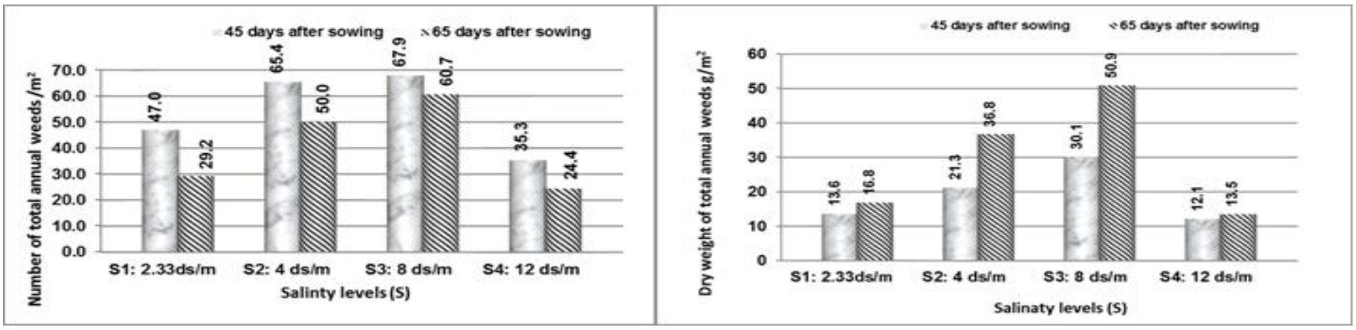


**Fig. 5. Effects of salinity levels on number($m^2$) and dry weight of total annual weeds ($gm^2$) of four barley cultivars at 45 and 65days after sowing (Combined data of two seasons)**

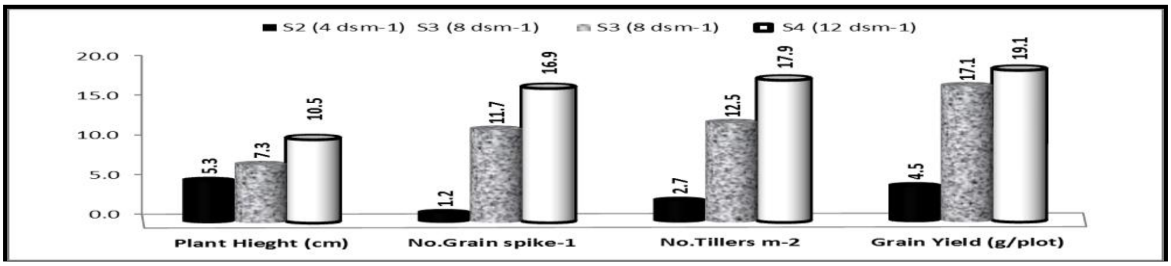


**Fig. 6. The average percentage of contribution reduction of weed interference on the studied traits under 4, 8and 12 $dSm^{-1}$ salinity levels**

**Table 6. List of multiplexing sets of the used seven SSR primers, name, sequence, chromosome location (Ch. Lo), band size, no. of alleles, polymorphism information contents (PIC) and polymorphism**

| No. | Primer Name | Sequence | Ch. Lo | No. of alleles | No. of polymorphic bands | PIC | Polymorphism % |
|---|---|---|---|---|---|---|---|
| 1 | Bmag770 | F:AAGCTCTTTCTTGTATTCGTG<br>R:GTCCATACTCTTTAACATCCG | 1H | 3 | 3 | 0.85 | 100 |
| 2 | GBM1459 | F- AACACATCCATACTTCCCCG<br>R- AGCTGAATAAATGCCCATGC | 2H | 1 | 0 | 0.0 | 0 |
| 3 | EBmac0871 | F:TGCCTCTGTTGTGTTATTGT<br>R: CCCCAAGTGAACATTGAC | 3 H | 2 | 2 | 0.51 | 100 |
| 4 | GBM1221 | F-ACCAGCAATCCAAGTTACGG<br>R-TGCCTTGGTCTTGGTGTGTA | 4H | 1 | 0 | 0.0 | 0 |
| 5 | Bmac0113 | F:TCAAAAGCCGGTCTAATGCT<br>R:GTGCAAAGAAAATGCACAGATA | 5 H | 1 | 0 | 0.52 | 0 |
| 6 | Bmac0040 | F- AGCCCGATCAGATTTACG<br>R- TTCTCCCTTTGGTCCTTG | 6H | 3 | 3 | 0.75 | 100 |
| 7 | Bmag0135 | F: ACGAAAGAGTTACAACGGATA<br>R: GTTTACCACAGATCTACAGGTG | 7H | 1 | 1 | 0.53 | 100 |
| Average | | | | 1.71 | 1.29 | | |
| Total | | | | 12 | 9 | | |

**Table 7. Scientific, English and family names for weeds species and their infestation percentage in together in 2019/ 20120 and 2020/2021 seasons**

| Scientific name | English name | Family | Infestation % of weeds species |
|---|---|---|---|
| **Broad-leaved weeds** | | | |
| *Chenopodium murale* L | Nettle leaf goosefoot | Chenopodiaceae | 33.5 |
| *Chenopodium album* L | White goosefoot | Chenopodiaceae | 11.5 |
| *Beta vulgaris* L | Sea beet | Chenopodiaceae | 10.5 |
| *Silybum marianum* L. | Mary's thistle. | Asteraceae | 12.4 |
| *Malva parviflora* L. | Cheese weed mallow | Malvaceae | 7.7 |
| *Sonchus oleraceus* L. | Sow thistle | Asteraceae. | 3.8 |
| *Medicago polymorpha* L. | Toothed medic. | Leguminosae | 3.3 |
| *Rumex dentatus* L. | Dentated dock | Polygonaceae | 2.2 |
| *Anagallis arvensis* L. | Scarlet pimpernel | Primulaceae | 1.0 |
| **Narrow-leaved weeds** | | | |
| *Phalaris minor* L. | Lesser canary grass. | Poaceae | 14.1 |

**Table 8. Effects of salinity levels and weed control treatments on number ($m^2$) and dry weight of annual weeds with four barley cultivars at 45 and 65 days after sowing (DAS) (Combined data of two seasons)**

| Treatments | Narrow- leaved of weeds | | | | Broad-leaved of weeds | | | | Total annual of weeds | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 45 DAS | | 65 DAS | | 45 DAS | | 65 DAS | | 45 DAS | | 65 DAS | |
| | No | DW | No. | DW | No. | DW | No. | DW | No. | DW | No. | DW |
| **Salinity $dSm^{-1}$ (S)** | | | | | | | | | | | | |
| 2.33 | 4.67c | 1.08c | 2.83c | 1.42c | 42.3c | 12.5b | 26.4c | 15.4c | 47.0c | 13.6c | 29.2c | 16.8c |
| 4 | 11.3b | 9.0b | 5.83b | 10.6b | 52.2b | 12.3b | 44.2b | 26.2b | 65.4b | 21.3b | 50.0b | 36.8b |
| 8 | 15.4a | 10.8a | 14.4a | 11.0 a | 54.5a | 19.3a | 46.3a | 39.9a | 67.9a | 30.1a | 60.7a | 50.9a |
| 12 | 2.67d | 1.05c | 2.3d | 1.0d | 32.7d | 11.1c | 23.4d | 12.5c | 35.3d | 12.1c | 25.7d | 13.5d |
| **Cultivars ( C)** | | | | | | | | | | | | |
| Giza 123 | 13.3a | 10.1a | 7.75b | 11.3a | 68.2a | 21.8a | 64.5a | 44.3a | 81.5a | 31.8a | 72.3a | 55.7a |
| Giza 132 | 11.7b | 8.92b | 9.58a | 9.33b | 53.3b | 12.9b | 30.1b | 14.8b | 64.2b | 21.8b | 39.7b | 24.1b |
| Giza 137 | 4.67c | 1.08d | 2.83d | 1.42d | 32.4c | 13.4b | 23.3c | 16.9c | 37.1c | 14.5c | 31.1c | 18.3c |
| Giza 138 | 3.33d | 1.42c | 4.92c | 1.67c | 27.8d | 7.00c | 22.3c | 18.0c | 31.2d | 8.4d | 27.3d | 19.7c |
| **Weed control treatments (T)** | | | | | | | | | | | | |
| Brominal+ Traksos | 1.94c | 1.44c | 2.69c | 1.44c | 5.06c | 1.69c | 7.69c | 6.56c | 7.00c | 3.13c | 10.4c | 8.00c |
| Hand weeding twice | 8.13b | 4.81b | 7.75b | 5.25b | 41.8b | 15.5b | 35.4b | 23.5b | 49.9b | 20.3b | 43.1b | 28.8b |
| Unweeded control | 14.7a | 9.88a | 8.38a | 11.1a | 89.4a | 24.2a | 62.1a | 40.4a | 104a | 34.1a | 70.5c | 51.6a |
| **Analysis of variance (F .test)** | | | | | | | | | | | | |
| Saline (S) | ** | * | ** | * | * | ** | * | * | * | * | * | * |
| Cultivars (C) | * | ** | * | ** | ** | ** | * | * | ** | * | ** | ** |
| Weed treatments (T) | ** | * | * | * | ** | ** | ** | ** | ** | ** | ** | ** |
| **F test (interaction)** | | | | | | | | | | | | |
| S X C | ** | * | ** | * | * | ** | NS | * | * | * | * | * |
| S X T | * | ** | NS | ** | NS | ** | * | * | ** | * | NS | ** |
| CX T | ** | * | NS | * | NS | ** | ** | ** | NS | ** | NS | ** |
| S XC XT | NS | ** | NS | ** | NS | ** | * | ** | NS | ** | ** | ** |

#### 3.2.2 Changes in barley cultivars

The relationship between the studied four barley cultivars and weed population was hesitative in spite of their salinity tolerance Table 7 to first weed survey, the relation of number and dry weight of *Phalaris minor* L. were (75.0 and 85.9%), respect lively, by Giza 138 (moderate of salinity degree), (75.2 and 85.9 %), respectively, by Giza 137 (tolerant of salinity degree), 12.5 and 11.5 %), respectively, by Giza 132 (sensitivity of salinity degree), compared to Giza 123 (tolerant of salinity degree), which had a highest values of weed population .For the reduction of number and dry weight of broad-leaved weeds (59.1and 67.7%), respectively, by Giza 138, (59.2 and 67.9%), respectively, by Giza 137, (21.9 and 40.6%), respectively, by Giza 132, compared to Giza 123. As for the reduction of number and dry weight of total two weeds categories (*P. minor* and broad-leaved weeds) were (61.7 and 73.5 %), respectively by Giza 138 (61.7 and 73.6 %), respectively, by Giza 137, (21.2 and 31.4%) respectively, by Giza 132, compared to Giza 123. In second weeds survey, the results were obtained by the previous respective barley cultivars showed similar results as observed in the first weeds survey with minor differences as shown in (Table 8, Figs. 7 & 8**).** The previous results may be due to the presented weeds were limited in a few species; furthermore, the barley plants had somewhat adoption to saline soils regardless of the different genotypes of its cultivars.

Additionally, the results showed that both Giza 137 and Giza 138 had lower reduction in all agronomic values of agronomic traits as they had lowest weeds association under salinity levels 8 and 12dsm$^{-1}$ (Figs. 8 &9), while Giza 123 had high reduction followed by Giza 132 in all agronomic as they had high weeds under salinity levels 2.33, 4, 8 and 12 dSm$^{-1}$.

### 3.3 Changes Due to Weed Control Treatments

#### 3.3.1 Changes in agronomic traits

Weed control treatments significantly increased all of the agronomic studied traits values (Table 5& Fig. 10) ,the results clearly indicate that treatment of ((Bromoxynil octanoate + (clodinafop propargyl + Pinoxaden )) was more efficient which gave the maximum values of PH, NGS, NT and GY over unweeded treatment with significantly increased by 19.7, 33.4, 34.1 and 39.1 % respectively Hand weeding twice treatments gave higher values of PH, NGS, NT and GY over the unweeded by 14.8, 28.2, 28.8 and 33.9 % respectively.

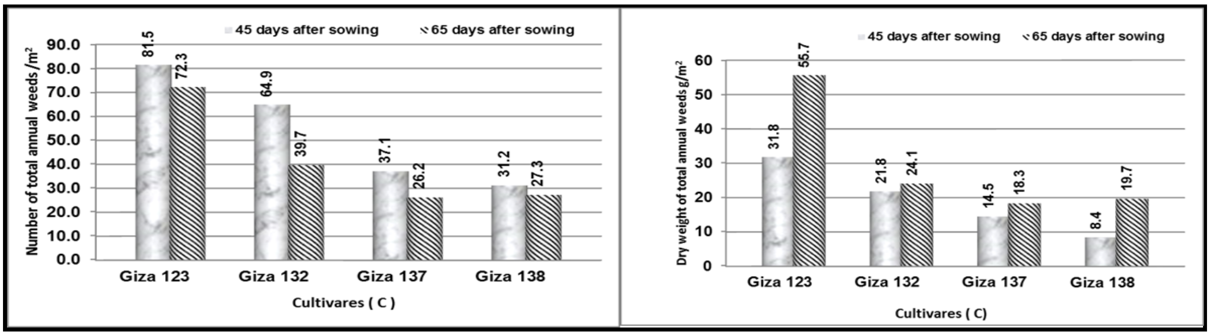


**Fig. 7. Effects of number (m$^2$) and dry weight of total annual weeds gm$^2$ on the four barley cultivars at 45 and 65 days after sowing (Combined data of two seasons)**

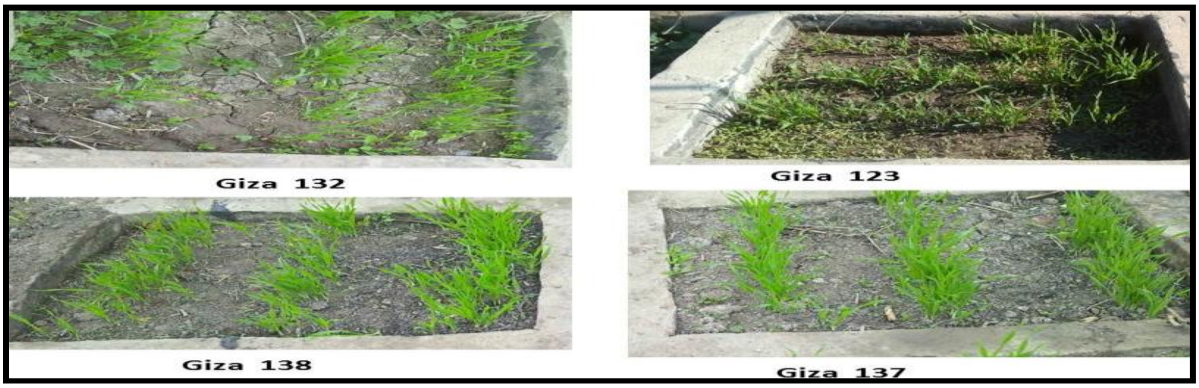


**Fig. 8. Barely / weeds species interference under salinity (2.33 dSm$^{-1}$) in unweeded control plots**

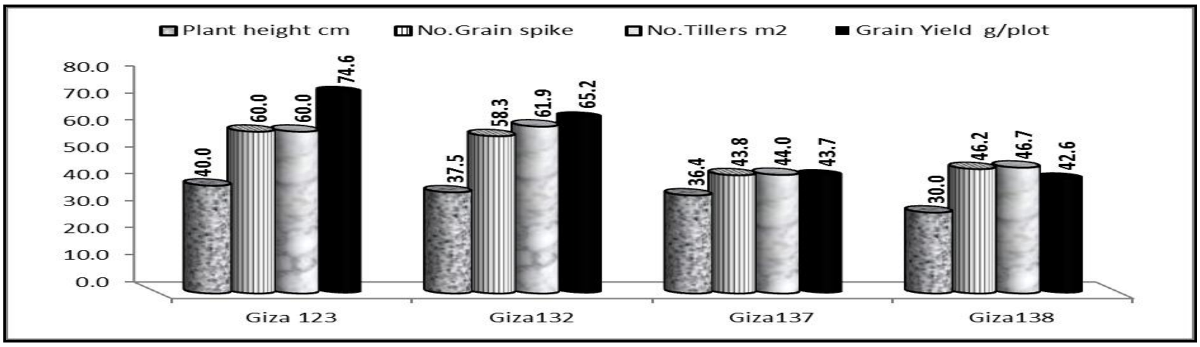


**Fig. 9.The average reduction percentage among the barley cultivars for all studied traits under 12 dSm$^{-1}$ salinity level as compere by 2.33 dSm$^{-1}$ due to weeds stress**

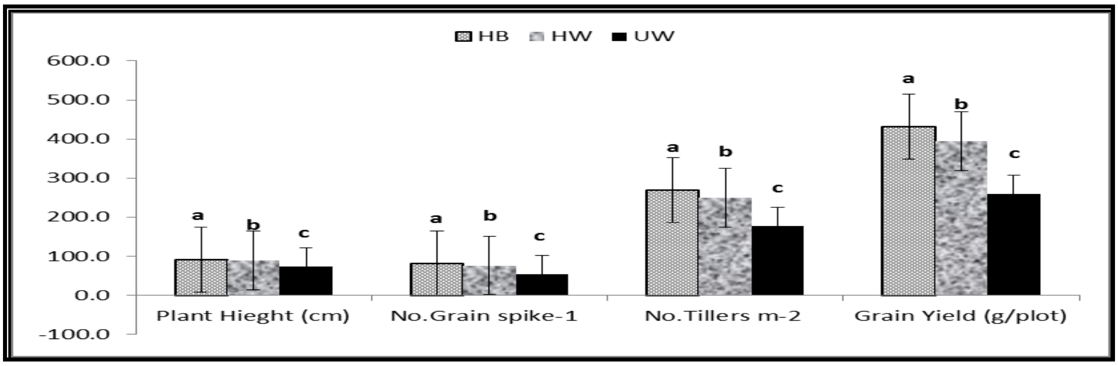


**Fig. 10. Effects of weed control treatments on agronomic traits of four barley cultivars (Combined data of two seasons) Which UW: Un-weeded, HW, twice hand weeding and HB : ((Bromoxynil octanoate + (clodinafop propargyl + Pinoxaden ))**

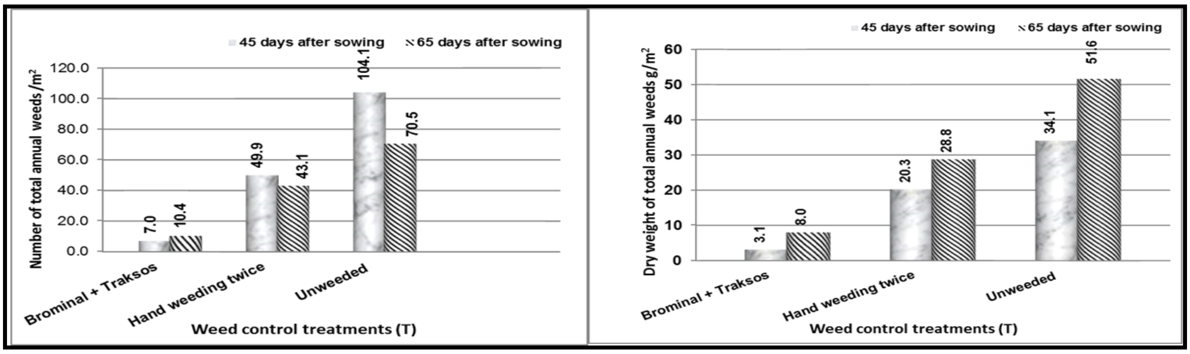


**Fig. 11. Effects of weed control treatments on number(m$^2$) and dry weight of total annual weeds (gm$^2$) of four barley cultivars at 45 and 65 days after sowing (Combined data of two seasons) H.B*: (Bromoxynil octanoate + (clodinafop propargyl + Pinoxaden**

### 3.3.2 Changes in weeds populations

It is clear from (combined analysis) in Table7, that the application of the herbicidal (bromoxynil octanoate at 1L fed$^{-1}$+ (clodinafop propargyl 2.5% + Pinoxaden 2.5%) at 0.5 L fed$^{-1}$) and hand weeding twice treatments were superior with significant effect on reducing weeds population compared to unweeded control.

For narrow weed (*Phalaris minor* L) the results showed that the herbicides treatment gave the highest reduction percentage on number and dry weight by (86.7% and 85.4%), and (67.9% and 87.1%,), in first survey at 45 DAS, (each as post-emergence) and second survey at 65 DAS, respectively compared to unweeded control. Hand weeding twice at 20 and 35 DAS was the following treatment to reduce the number and dry weight by 44.7% and 51.3%, respectively, in first survey, and 7.51% and 52.8%, respectively, in second survey, compared to unweeded control.

Hand weeding twice treatment gave the following significant reduction percentage on the number and dry weight by 53.2 and 36.1%, respectively, in first survey, and 43.1 and 41.9%, respectively, in second survey, compared to unweeded control. Likewise, the results were obtained by weed control treatments for the total two categories of weeds (*Phalaris minor* L. and broad-leaved weeds) showed similar significantly results all these observed in each category individually in first and second in both seasons together as shown (Fig. 11).

## 3.4 Changes Due to the Interaction Among Salinity and Weed Control Treatments

### 3.4.1 Changes in agronomic traits

Concerning , the effect of the interaction among different salinity levels , the four cultivars and weed control treatments, data clearly show that different weed control treatments significantly caused the highest increases in all of plant height , No. of grain spike$^{-1}$ , No. of tillers m$^{2}$ and grain yield values of the Egyptian cultivars Giza 123, Giza 132 , Giza 137 and Giza 138 cultivars under (2.33, 4 ,8 and 12 dSm$^{-1}$) as presented in Table 5.

The highest grain yield was obtained by Giza 137 as a salt tolerance cultivars when irrigated by salinity level of 2.33, 4, 8 and 12dS m$^{-1}$ with using the herbicide ((Bromoxynil octanoate + (clodinafop propargyl + Pinoxaden )) treatment and followed by two hand weeding treatment as camper by unweeded treatment. For Giza 123 as salt cultivars had higher grain yield higher than Giza 138 as a moderated salt tolerance under 2.33 and 4 dSm$^{-1}$ as compere by unweeded treatment, but at the salinity levels 8 and 12 dSm$^{-1}$ Giza 123 had lower grain yield (244.9 and 90.0 g plot$^{-1}$) than Giza 138 (246.0 and 100.0 g plot$^{-1}$) respectively. Nevertheless, by using ((Bromoxynil octanoate + (clodinafop propargyl + Pinoxaden )) herbicides treatment the results showed that Giza 123 had higher gain yield (485.3 and 319.2 g plot-1) than Giza 138 (457.7 and 251.7 g plot-1) respectively when irrigated salinity levels 8 and 12 dSm$^{-1}$. While , the lowest gain yield was recorded for Giza 132 from all weeded control treatment (Fig. 12**).**

### 3.4.2 Changes in weeds population

With respect to the effect of interaction among weed control treatments, different salinity levels and the four cultivars were affecting significantly on number and dry weight of narrow-leaved, broad-leaved and total annual weeds. The results clearly show that different weed control methods significantly reduced number and dry weight of total annual weeds at 45 and 65 days after sowing (DAS) as shown in Table (8).The application of herbicide treatment (Bromoxynil octanoate + (clodinafop propargyl + Pinoxaden )) with cultivars (Giza 132, Giza 137 and Giza138) caused enormous reduction on number and dry weight of total annual weeds by 17.3, 58.3 and 61.9% and 37.2, 65.2 and 68.2% at average two surveys under all salinity levels of irrigation more that the hand weeding treatments, as compared to Giza 123 and unweeded treatment as showed in Fig. (13A,B,C&D).

## 3.5 Multivariable Analysis

### 3.5.1 Pearson correlation coefficients

Data presented in Fig. 14 indicated clearly that the pearson correlation coefficients between were showed strong negatively and significantly corrected with No. and dry weight of presented weed species at 45 and 65 days after sowing with plant height (PH) and No. of tillers (NTm$^{2}$), and less negative correlation were found between grain yield (GYgm2), No. of grain spike$^{-1}$(NGS) and No. and dry weight of presented weed species at 45 DAS These results may be due to the weeds competition with their all elochemicals on barley development.

### 3.5.2 Genotype by Treatment (GTr) biplot

Effects of interaction between four salinity levels and three weed control treatments (forming 12 treatment combinations) on grain yield of four barley cultivars were summarized and graphically, illustrated in polygon graph view Fig. (15**)** It is observable that the GTr biplot model accounts for 98.66% of the total variance representing 91.29 and 7.36 % variance attributable to the first and second principal component (PC1 and PC2), respectively. The results revealed that cultivars Giza137 and Giza123 allocated on positive part of right graph had the highest grain yield under salinity and weed control treatments. On the other hand, the vertex cultivars Giza132 were placed far from most or all measured treatment, indicating to their lowest values with poor performance toward the salinity under control weed treatment. Also then From Comparison GTr biplot graph illustrated that the application of herbicide treatment (Bromoxynil octanoate + (clodinafop propargyl + Pinoxaden ) was useful in obtaining to preferred barley production under moderated and high salinity irrigation supplements. Furthermore**,** the application of hand weeding twice was useful in obtaining to desired response in barley production under both 2.33 and 4 salinity irrigation supplements.

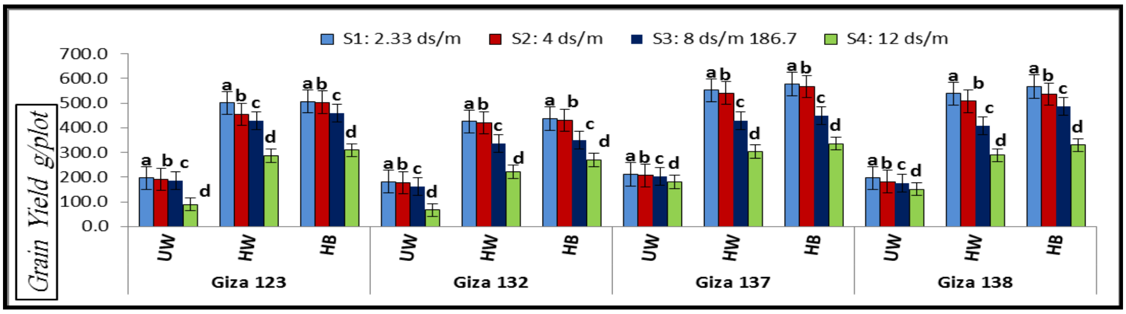


**Fig. 12. Effects of interaction between salinity levels and weed control treatments on grain yield of the Giza 123,Giza 132m Giza 137 and Giza 138 (Combined data of two years) UW: Un-weeded, HW, hand weeding twice and HB : ((Bromoxynil octanoate + (clodinafop propargyl + Pinoxaden ))**

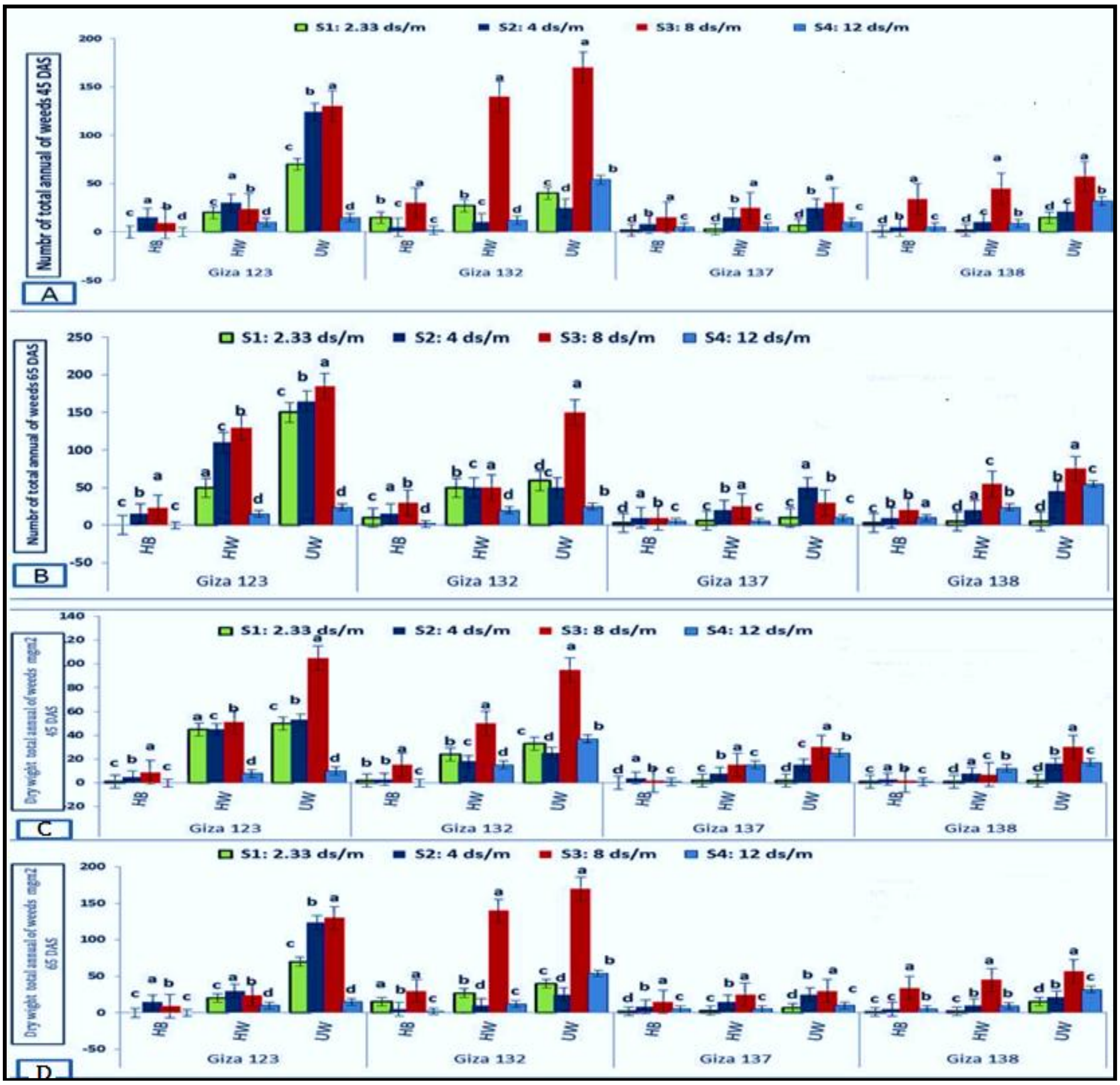


**Fig. 13. Effects of interaction between salinity levels and weed control treatments on number of total annual weeds ($m^2$) of four barley cultivars at 45 and 65 after sowing (Combined data of two years) Which UW: Un-weeded, HW, hand weeding twice and HB : ((Bromoxynil octanoate + (clodinafop propargyl + Pinoxaden ))**

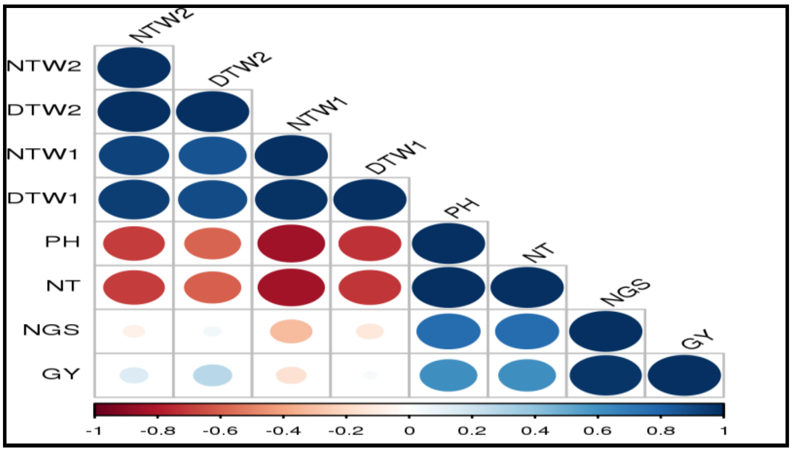


**Fig. 14. Pearson correlation coefficient heatmap among all studied traits under salinity levels. Correlation key and the scale reads, red circle indicted negative correlation, blue circle indicted positive correlation, white circle mean no correlation smaller circle indicted lesser significance; bigger circle indicted greater significance. The color intensity and the size of the circle are relative to the correlation coefficients. .Abbreviations of traits were PH: plant height, NGS: No of grain spike, NT: No. of tillers m$^2$, GY , grain yield , NTW1: No. of total weeds at 45 DAS ,NTW2: No. of total weeds at 65 DAS, DTW1: dry weight of total weed at 45 DAS and DTW2: dry weight of total weed at 65 DAS**

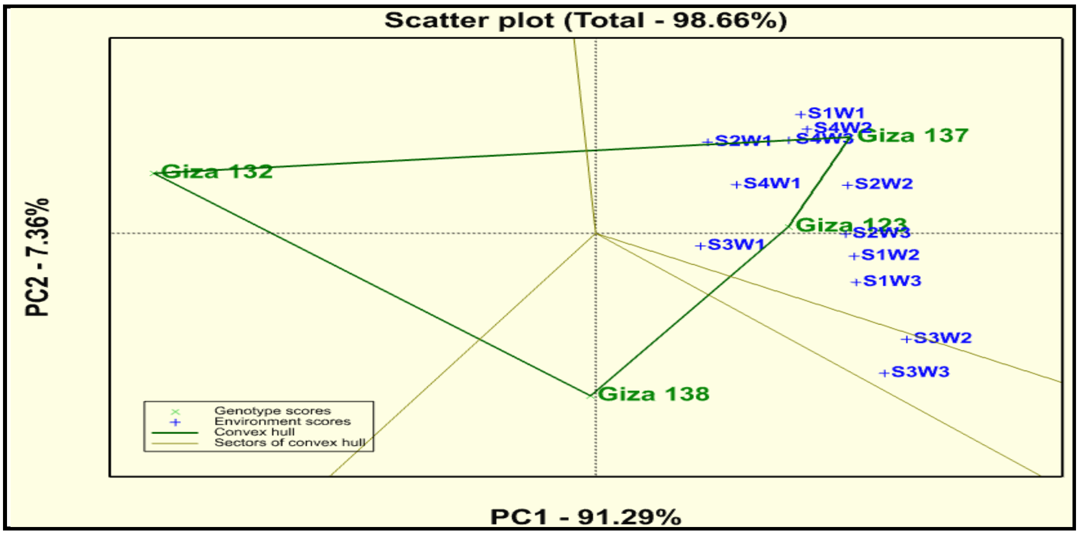


**Fig. 15. GGE-biplot polygon view of the four cultivars scores under different treatments combination (salinity stress/weed control) , Treatments combination of salinity irrigation/weed controls (S1W1: 2.35/HB, S1W2: 2.35/HW, S1W3: 2.35/UW , S2W1: 4/HB, S2W2: 4HW S2W3: 4/UW, S3W1: 8/HB, S3W2: 8W, S3W3: 8/UW, S4W1: 12/HB, S4W2: 12/HW, S4W3: 12/UW**

### 3.5.3 Economic evaluation analysis

Results in Table (9) showed all the interactions between the three studies factors salinity level at 2.33 dsm$^{-1}$ ,two weed control treatments and the four barley cultivars gave the highest values of net return, benefit/ cost ratio and profitability%. On the contrary, the lowest values of these economic parameters were obtained by all the interactions between salinity level at 12 dsm$^{-1}$, unweeded control and the four barley cultivars on the other hand, the interactions between salinity level at 2.33 dsm$^{-1}$ and the herbicide gave the highest values of net return, benefit/ cost ratio and profitability% by 22320 L.E fed$^{-1}$, 3.752 and 275.22%, respectively. The following highest values of the respective previous economic parameters were obtained by the above interactions after change the salinity level at 2.33 dsm$^{-1}$to 4dsm$^{-1}$ by 21064, 3.597 and 259.7%. Also, the interactions between salinity levels at 2.33 dsm$^{-1}$ to 4dsm$^{-1}$ and of the weed control treatments and each of Giza 132, Giza 123 and Giza 138 gave the following highest values of the previous economic parameters.

**Table 9. Effect of interaction between cultivars, saline levels and weed control treatments on economic evaluation of barely crop (Combined data of two seasons)**

| Cultivars | Saline levels (dSm$^{-1}$) | weed control treatments | Total income (L.E./fed) | Total cost (L.E./fed) | Net farm return (L.E./fed) | Benefit/Cost ratio (B/C) | Profitability (P) |
|---|---|---|---|---|---|---|---|
| Giza 123 | 2.33 | Brominal + Traksos | 30484 | 8110 | 22374 | 3.759 | 275.88 |
| | | Hand weeding (twice) | 27668 | 9510 | 18158 | 2.909 | 190.94 |
| | | Unweeded control | 21553 | 7510 | 14043 | 2.870 | 186.99 |
| | 4 | Brominal + Traksos | 26577 | 8110 | 18467 | 3.277 | 227.71 |
| | | Hand weeding (twice) | 24082 | 9510 | 14572 | 2.532 | 153.23 |
| | | Unweeded control | 18004 | 7510 | 10494 | 2.397 | 139.73 |
| | 8 | Brominal + Traksos | 23549 | 8110 | 15439 | 2.904 | 190.37 |
| | | Hand weeding (twice) | 21984 | 9510 | 12474 | 2.312 | 131.17 |
| | | Unweeded control | 13258 | 7510 | 5748 | 1.765 | 76.54 |
| | 12 | Brominal + Traksos | 17729 | 8110 | 9619 | 2.186 | 118.61 |
| | | Hand weeding (twice) | 15270 | 9510 | 5760 | 1.606 | 60.56 |
| | | Unweeded control | 6727 | 7510 | -783 | 0.896 | -10.43 |
| Giza 132 | 2.33 | Brominal + Traksos | 28557 | 8110 | 20447 | 3.521 | 252.12 |
| | | Hand weeding (twice) | 27938 | 9510 | 18428 | 2.938 | 193.77 |
| | | Unweeded control | 16408 | 7510 | 8898 | 2.185 | 118.48 |
| | 4 | Brominal + Traksos | 28523 | 8110 | 20413 | 3.517 | 251.71 |
| | | Hand weeding (twice) | 27026 | 9510 | 17516 | 2.842 | 184.19 |
| | | Unweeded control | 16765 | 7510 | 9255 | 2.232 | 123.24 |
| | 8 | Brominal + Traksos | 23558 | 8110 | 15448 | 2.905 | 190.48 |
| | | Hand weeding (twice) | 22090 | 9510 | 12580 | 2.323 | 132.28 |
| | | Unweeded control | 12208 | 7510 | 4698 | 1.626 | 62.56 |
| | 12 | Brominal + Traksos | 18850 | 8110 | 10740 | 2.324 | 132.43 |
| | | Hand weeding (twice) | 14083 | 9510 | 4573 | 1.481 | 48.09 |
| | | Unweeded control | 5194 | 7510 | -2316 | 0.692 | -30.84 |
| Giza 137 | 2.33 | Brominal + Traksos | 30430 | 8110 | 22320 | 3.752 | 275.22 |
| | | Hand weeding (twice) | 29111 | 9510 | 19601 | 3.061 | 206.10 |
| | | Unweeded control | 23065 | 7510 | 15555 | 3.071 | 207.12 |
| | 4 | Brominal + Traksos | 29174 | 8110 | 21064 | 3.597 | 259.72 |
| | | Hand weeding (twice) | 27851 | 9510 | 18341 | 2.929 | 192.86 |
| | | Unweeded control | 19873 | 7510 | 12363 | 2.646 | 164.62 |
| | 8 | Brominal + Traksos | 23059 | 8110 | 14949 | 2.843 | 184.33 |
| | | Hand weeding (twice) | 22038 | 9510 | 12528 | 2.317 | 131.73 |

| Cultivars | Saline levels (dSm$^{-1}$) | weed control treatments | Total income (L.E./fed) | Total cost (L.E./fed) | Net farm return (L.E./fed) | Benefit/Cost ratio (B/C) | Profitability (P) |
|---|---|---|---|---|---|---|---|
| | | Unweeded control | 14308 | 7510 | 6798 | 1.905 | 90.52 |
| | 12 | Brominal + Traksos | 18281 | 8110 | 10171 | 2.254 | 125.42 |
| | | Hand weeding (twice) | 16461 | 9510 | 6951 | 1.731 | 73.09 |
| | | Unweeded control | 9457 | 7510 | 1947 | 1.259 | 25.93 |
| Giza 138 | 2.33 | Brominal + Traksos | 29466 | 8110 | 21356 | 3.633 | 263.33 |
| | | Hand weeding (twice) | 26741 | 9510 | 17231 | 2.812 | 181.19 |
| | | Unweeded control | 17521 | 7510 | 10011 | 2.333 | 133.30 |
| | 4 | Brominal + Traksos | 30360 | 8110 | 22250 | 3.744 | 274.35 |
| | | Hand weeding (twice) | 26452 | 9510 | 16942 | 2.781 | 178.15 |
| | | Unweeded control | 15610 | 7510 | 8100 | 2.079 | 107.86 |
| | 8 | Brominal + Traksos | 25913 | 8110 | 17803 | 3.195 | 219.52 |
| | | Hand weeding (twice) | 21126 | 9510 | 11616 | 2.221 | 122.15 |
| | | Unweeded control | 13048 | 7510 | 5538 | 1.737 | 73.74 |
| | 12 | Brominal + Traksos | 19369 | 8110 | 11259 | 2.388 | 138.83 |

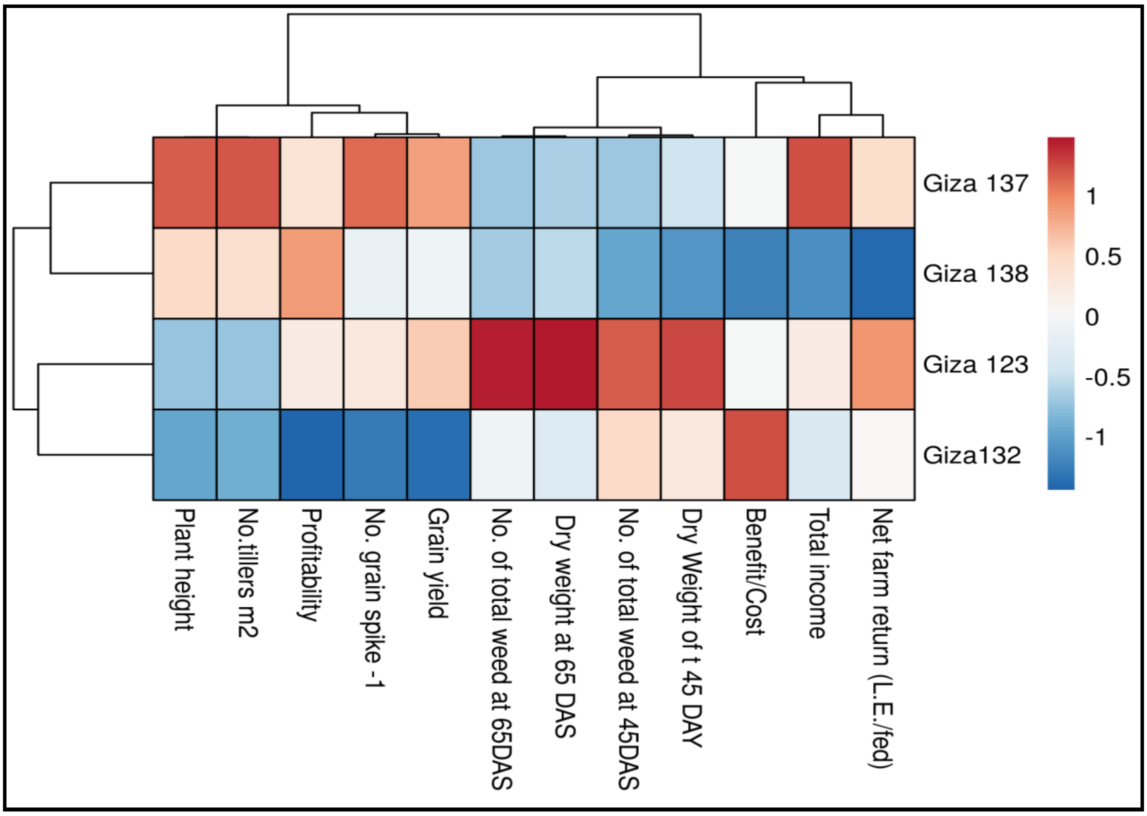


**Fig. 16 .Cluster heat map visualization of different traits on barley under the interaction between salinity and weed control. Dark Red indicates highest values of traits, whereas lowest values are dark blue. Row dendrograms show the similarity between the four cultivars. Column dendrograms show the similarity between all studied traits under study treatments condition**

In order to understand the relationships between the multivariate compound 12 phenotypic studied traits and the four cultivars under salinity and weed control treatments cluster heat map visualization was done and graphically presented in (Fig. 16). The dendrogram was obtained using hierarchical clustering (Euclidean distance and average linkage). The colors of heat map represent the relationship matrix value (dark red) indicate highest values of traits; whereas lowest values are (dark blue).The columns and the rows dendrogram are the result of a hierarchical clustering calculation in heat map. Row dendrogram show the similarity between the four cultivars, which were distributed into two main clusters. The first cluster contained (Giza 137) and the second cluster included (Giza 138, Giza 132 and Giza 123). Column dendrogram show the similarity between 12 morphological traits, divided into two main clusters. The first cluster concluded eight traits (net farm return, total income, probability, and benefit cost, number of tillers $m^2$, plant height, grain yield and number of grain $spike^{-1}$). The second cluster contained four traits (dry weight of total weeds at 45 days, number of total weeds at 45 days, dry weight of total weeds at 65 days and number of total weeds at 65 days). Results showed that Giza 137 had the highest values (dark red cells) for almost of studied traits while had lowest values with weeds population traits (dark blue cells). Giza 123 had high values for agronomical and economical traits (light blue cells) and had the highest values for weeds population's traits.

## 4. DISCUSSION

### 4.1 Changes Due Salinity on Barley Yield and its Weeds Associated

Soil Salinity is a most abiotic stress caused great reduction on barley grain yield [37-39] as well, saline water irrigation is one of constrains facing barley production in Egypt [40]. In this study, irrigation by saline water salinity had a negative effect on barley production while had a positive effect on barley weeds association. The results showed that the salinity levels significantly affected all studied characters across the two growing seasons, the increasing the salinity levels caused a strong significant in plant height with average reduction 29.5 % , No. of tillers $m^2$ (41.4%) , No. of grain $spike^{-1}$ (47.1 %) and grain yield (55.4 %) due to increasing salinity stress from 2.33 to 12 $dSm^{-1}$. Similar results were founding by [41-44]. they reporter that irrigation by saline water caused a strong reduction in barley yield.

Using seven SSR markers were amplified 12 alleles with average 1.71 per locus with a range from 1 to 3 alleles, which SSR primer (Bmag 770, 1H) had highest number of bands with three fragment and highest PIC was (0.85) which amplified specific allele with molecular size 260 bp found in the tolerance cultivars (Giza 123 and Giza 137) and was absent in Giza 132 and Giza 138 as a positive marker for salt tolerance .Our results were in good harmony with Mariey et al. and Brbakli´c et al. They used SSR markers to investigated genetic diversity and genetic relationship among barley genotypes for salt stress conditions and they reported that the SSRs technique could consider as powerful tool for genetic studies in barley breeding for salinity stress. Consequently, form the results of the effect of salinity levels on the studied agronomic traits and DNA analysis studied we could consider that Giza 137 is a Egyptian salt tolerance cultivar as Giza 123, and Giza 138 as a Egyptian moderated salt tolerance cultivar.

As a positive effect of salinity levels on the barley weeds association, the finding results showed that the salinity caused a significant increasing in both number and dry weight of *Chenopodium murale* L. as annual broad-leaved and *Phalaris minor* L. as narrow-leaved of weeds. Therefore, we could consider that both of *Chenopodium murale* L. and *Phalaris minor* L. as the most and important salt tolerance barley weeds associated. As well as , the results showed that the lowest number and dry weight of narrow-leaved and broad-leaved were associated with Giza 137 followed by Giza 138, while, the highest number and dry weight of annuals weeds were associated with Giza 123 followed by Giza 132 under salinity stress.

## 4.2 Changed Due Weeds Stress on Barley Yield and Cultivars

Weed interference are the most biotic also caused greatest reduction on barley yield , this reduction is differ according to weed density, type, persistence their direct competition for light, moisture, soil nutrients and crop-management practices [45,46]. Both salinity and weeds stresses were the most important factors affects barley production in Egypt .From our results we found that weeds interference and salinity levels both cased a huge reduction in barley yield which the weeds stress contributed in decreasing all the studied traits by 10.5, 16.9, 17.9 and 19.1 % reduction in PH, NGS , NT and GY under high salinity levels from 2.33 to 12 $dsm^{-1}$. This massive reduction refer to increasing weeds population due the effect of salinity on weeds , which salinity made shock to sensitive plants and led to reduce plants germination rate so this is good condition for different weeds to grew up by its compete with plant these results were in agreement reported by El –Metwally et al. [47] and Hakim et al. [48] whose reported that weeds infestation consider the most significant problematic in causing yield loss under salinity through weeds compete plants for light, water and minerals. Conversely, Kotzaman et al. [49] suggesting that increasing weeds under salinity may be refers to allopathic potential which probably decreases under high salinity through reducing the phytotoxicity of allopathic substances extracts.

## 4.3 Changed Due Weed Control Treatments

Weed control treatments is one of the essential cultural practices for raising yield and improving its quality. Hand weeding and herbicide applications have been the most conspicuous conventional weed control approaches, which assisted to keep weed capacity low so help improving crop production [50] in this study weed control treatments significant increased all studied traits, the results clearly indicate that herbicide treatment (bromoxynil octanoate + (clodinafop propargyl 2.5% + Pinoxaden 2.5%)) was more efficient that hand weeding twice which gave the maximum values of all measured traits over unweeded treatment.

Besides, weed control treatments were used to reducing weeds, the results showed that the herbicide treatment (bromoxynil octanoate + (clodinafop propargyl 2.5% + Pinoxaden 2.5%)) was more effectual and applied the highest reduction in number and dry weight of broad-leaved, narrow-leaved, and total annual weeds when paralleled with unweeded treatments. This reduction of weed dry weight may be due to the effect of herbicidal activity, which herbicides made an inhibition in photosystems II, lipid synthesis and coenzyme carboxylase (ACCase) (acetyle CoA carboxylase) of weeds. This inhibition gives barley chance to grow up naturally without the dangerous competition of weeds. These results are in general agreement with those recorded by [51-53]. As for, weed competition ability is an important tool in integrated weed management systems which have major effects on yields and economic returns of the crops, which help in reducing weed [53]. We found from our results that lowest number and dry weight of narrow and broad-leaved were associated with Giza 137 followed by Giza 138, while, the highest number and dry weight of annuals weeds were associated with Giza 123 followed by Giza 132. This low or high weed associated we could mentioned it to that the

Egyptian barley cultivars Giza 137 and Giza 138 had high weed tolerant ability (WTA), while (Giza 132 and Giza 123) had poor weed tolerant ability WTA. Watson et al., found that barley genotypes had a strong to medium competitive ability against weeds. This different competitive ability between the barley cultivars may be referring to its content of phenol concentration in their grain. Both Giza 137 and Giza 138 had high phenol content in their grain were (68.7 and 60.7 mg $100g^{-1}$) respectively, while Giza 132 and Giza 123 had low phenol content were (58.3 and 53.2 mg $100g^{-1}$). Thus, we could consider that both Giza 137 and Giza 138 as allopathic cultivars for their high content of phenol content while Giza 132 and Giza 123 as low WTA since their low phenol content. Our results agree with Robert and ben-hammouda, and Jabran et al. They stated that the phenolic compounds belong to the class of allopathic substances, which played an important role in barley plant against their associated weeds .

### 4.4 Multivariable Analysis

Negative correlations were found between all agronomical traits and weeds population traits under salinity stress. GGE-biplot was used to draw the polygon graph view for interaction between genotypes and environments (G×E) In this study it is observable that the GGE-biplot model accounts for 98.66% of the total variance representing 91.29 and 7.36 % variance attributable to the first (PC1) and second (PC2) principal component respectively. Giza 137, Giza 123 and Giza 138 are located on the right of the original points, which recorded highest average grain yield under salinity and weed control treatments .While Giza 132 located at the left of the origin point were less than those of other positions [52,53]. They studying of genotype-by environment interaction (GEI) in barley and they reported that (GEI) analysis plays an important role for identifying high-yield and stable genotype under environment's stress

Nowadays it is cumbersome to control weeds manually in barley cultivation. It can be concluded that the maximum crop yield as well as net return, profitability and B-C ratio can be obtained by the application of (bromoxynil octanoate + (clodinafop propargyl 2.5% + Pinoxaden 2.5%) )with the effective control of broad-leaved and narrow-leaved weeds. Reduced productivity due to the presence of weed density associated with saline lands and the competitive ability of the cultivars. It was necessary to conduct an economic assessment of expenditures on the barley crop and find packages of appropriate recommendations. Results in Table 9 showed that due to keep the tolerant cultivars (Giza 137) under saline levels and dry weight of total annual weeds reasonably at least level and increasing the crop production of barley consequently, rising economic return. As the economic criteria showed that for controlling weeds and labor is expensive, so it was necessary to apply an integrated control of weeds and weeds in the barley crop in salty lands by using tolerant cultivars. In addition, use the herbicides which will give the highest reduction in total annual weeds and will increase barley yield and its components.

The relationships between the multivariate compound 12 phenotypic studied traits and the four cultivars were presented in a heat map hierarchical cluster using the module of a heat map of ClustVis constructed using R software (Fig. 16). The result of a clustering is presented the similarity between the clustered rows (barley cultivars ) and columns (12 phenotypic studied traits) showed that Giza 137 and 123 had the high means values for alomest traits. The economic traits revealed the most correlated each to other, meaning estimate any of them is index to the other especially under . As well as, number of grain $spike^{-1}$ trait used as indicator to increase the grain yield productivity. Meanwhile, any of the traits in the second cluster was indicator to the low yield performance.

## 5. CONCLUSIONS

The present study, SSR markers were used to screen different four barley cultivars Giza 123, Giza132, Giza137 and Giza138 for their tolerance against four salt levels as 2.35, 4, 8 and 12 $dsm^{-1}$. Furthermore to chaise subtitle methods for controlling the weeds species associated barley fields. The main findings showed that Giza137 and Giza 123 were barley genotypes suitable for cultivation in saline soil and tolerant to saline water irrigation , and both Giza 137 and Giza 138 were showed highest weed competitive ability compared to the other cultivars, so they it can good grow in newly reclaimed land. On the other hand a bromoxynil octanoate at 1L $fed^{-1}$ plus (clodinafop propargyl 2.5% + Pinoxaden 2.5%) at 0.5 L $fed^{-1}$ can be used with softy and effective on controlling weeds species in barley fields. This herbicidal treatment was superior hand weeding twice at 20 and 35 days after sowing. Noticed, the hand weeding treatment is not feasible on the lag scale, especially with cereals crops. Therefore, the Giza 137 and Giza 138 provide sustainable weed management and should be part of long-term strategies for reducing the weed under salinity soil

## 6. FUTURE OUTWORK

There is not much work about barley competitive weeds and weed control under saline environment.

Therefore, future studies should focus on the efficacy of weed control treatments and its influence on physiological ,biochemical and grain quality traits of barley plants the side effects of chemical treated ,also need to study the economics analysis in lager scale on field area to increasing farmer's income in that area which weeds are the most negative effect on barley under salinity area.

## DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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