ACCEPTED ARTICLE

Salinity Tolerance Screening in Iranian and Afghan Melons (*Cucumis melon*) Based on Several Associated Morphological and Physiological Traits

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ABSTRACT

This study aimed to investigate the effect of salinity on morphological and physiological traits of native Iranian melon landrace and Afghan melon cultivars using a split-plot experiment with a Randomized Complete Block Design in three replications. Two salinity levels (2 and 8 dSm^{-1} NaCl) and 39 cultivars from Iran and Afghanistan were used in this study. PCA comparisons were done between morphological and physiological parameters. The sensitive and tolerant cultivars were chosen based on proximity to high yield, morphological characteristics, and distance from stress indices. The biplot results showed a high correlation between vitamin C traits with soluble solids, proline, and relative water content and a negative correlation with Fv/Fm ratio. These indices are good indicators for identifying saline resistance cultivars. Salinity stress increased electrolyte leakage, proline concentration, total antioxidant activity, sodium content, vitamin C, organic acid, and total soluble solids. In addition, salinity decreased the yield, mean fruit weight, firmness, fruit length, fruit width, internal cavity length, internal cavity width, flesh thickness and fruit peel thickness, Fv/Fm ratio, greenness index, relative water content, leaf potassium. The highest concentrations of sodium were found in the Gorgi Shirdan Jorgeaval cultivar under salinity, while the highest concentrations of potassium were found in the Torkamani cultivar under non-saline conditions. Analysis revealed two types of Torkamani and Zanki melon which are recommended to plant in saline conditions.

Keywords: Abiotic stress, Genetic diversity, Melon yield, Resistance cultivar, Salinity, Total antioxidant activity

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INTRODUCTION

Melon (*Cucumis melo* L.) is one of the world's significant horticulturale crops, growing extensively in arid and semiarid regions (Akrami and Arzani, 2018). Iran plays a significant role in global melon production, with an annual output of approximately 854,000 tons from a cultivated area of 40,500 hectares. (Sarabi and Ghashghaie, 2022).

Salinity in the growing environment is one of the limiting factors in crop production. Due to the use of excessive fertilizers and excessively saline water, saline environments are a significant contributor to the rise in agricultural stress conditions (Dias *et al.*, 2018). The salt ratio in the environment has a significant impact on various biochemical and physiological processes in plants (Tarchoun *et al.*, 2022). High salinity levels can have negative effects on seed germination and disrupt several physiological and metabolic processes, including changes in enzymatic activities (Tarchoun *et al.*, 2022). It is important to identify the ideal conditions to determine stable genotypes that can withstand different types of stress. The performance and productivity of genotypes are influenced by multiple factors, including abiotic stresses (Yaşar, 2023).

Under salt stress, osmotic potential due to limited water uptake from the soil and ion toxicity cause cell dysfunction and damage to physiological activities, such as photosynthesis and respiration, resulting in diminished plant growth and development at various growth stages (Deinlein *et al.*, 2014). Plants, being unable to move, have developed complex systems and adaptive responses to cope with salt stress. When the soil contains high levels of salinity, sodium and chloride ions accumulate, leading to a decrease in the availability of essential nutrients and water for plants (Van Zelm *et al.*, 2020). Maintaining a balance between potassium (K^+) and sodium (Na^+) is crucial for plants to tolerate salt stress. Therefore, effective regulation and compartmentalization of Na+ and K+ homeostasis play a critical role in enhancing salt stress tolerance in plants (Almeida Almeida *et al.*, 2017; Sheikhalipour *et al.*, 2022).

The salinity tolerance threshold for melon is 2.2 dSm^{-1}. Melon is a salt-sensitive crop (Silva *et al.*, 2020). The electric conductivity (EC) value of 3.31 dSm^{-1} has no significant effect on melon production, according to Silva *et al.* (2020). In contrast, when the soil is irrigated with water and a high percentage of salt, a decrease in productivity is typically observed. According to Silva *et al.* (2020), to correct the osmotic potential within the cell, melon eliminates Na^+ and Cl^- ions and synthesizes suitable solutes, such as proline and citrulline. According to Pereira *et al.* (2017), increasing irrigation water salinity lowers the growth, dry mass, and physiological attributes of melon cultivars. However, extensive research on the reaction of melons to salinity has revealed that melons' tolerance to salinity is cultivar-dependent (Dias *et al.*, 2018). Some melon cultivars are tolerant of salinity because they have more effective mechanisms for stress resistance, allowing them to be grown in salinized environments (Silva *et al.*, 2020). Pereira *et al.* (2017) investigated five melon cultivars and identified Sancho as most salinity-tolerant, followed by Mandacaru, Medelln, Sedna, and Néctar.

The comparison between Iranian and Afghan melons in this study was conducted to examine the physiological differences and similarities between these two populations. This comparison can contribute to a better understanding of salt tolerance traits in melons and help improve their performance and select suitable varieties for saline and harsh environmental conditions. Additionally, comparing with Iranian melon populations can provide insights into the genetic diversity and improvement potential in Iranian melon populations. Generally this study investigated the responses of Iranian melon landrace and Afghan melon to salinity to determine: i) the effect of salinity stress on growth and yield; ii) the identification of some physiological markers of salinity tolerance, and iii) the selection of salinity-tolerant cultivars for future study and recommended to cultivate in the saline region.

MATERIALS AND METHODS

Experimental Design (First Experiment)

The study involved using different types of melons from Iran and Afghanistan. These melons were grown with two different levels of salt in the irrigation water including , S1=2 dSm^{-1} of NaCl as the control and S2=8 dSm^{-1} of NaCl as the salinity stress. Every three weeks, plants were irrigated with control water to prevent excessive accumulation of salts. The experimental design was performed as split-plot randomized blocks, with two irrigation levels, melon genotypes, and three replications consisting of three biological replicates. The experiment was conducted at the Isfahan University of Technology Lavark Research Farm Station, located in Najaf Abad (32°32′N, 51°23′E, 1630 m above mean sea level), Iran. The soil texture was clay loam, thermic Typic, Haploargids with a bulk density of 1.4 g cm^{-3} and an average pH of 7.5. Based on initial investigation, plowing, animal manure, and chemical fertilizers were applied to the soil. In the supplementary file, Table 1 and Figure 1 describe 39 types of melons from Iran and Afghanistan, including 14 varieties landrace from central Iran and 26 from the southwest of Afghanistan. These melons were cultivated in fourteen rows, with seven rows serving as control treatments and the other seven rows as salinity treatments. The rows were spaced 2 meters apart and 36 meters in length.

The plants were spaced apart by 50 cm. At the four-leaf stage of the melon seedling, two salinity levels of 2 and 8 dSm^{-1} were applied. The plants were irrigated (once every 4-6 days) using drip irrigation systems with a dripper distance of 50 cm, based on its water requirements. At the time of harvest the fruit Morpho-physiological characteristics were evaluated and described according to descriptor (ECPGR, 2008).

Measured Parameters

After harvesting, each fruit was individually tallied and weighed. The average quantity and weight of fruits were determined. The yield per plant per square meter was estimated using the average plant weights.

A ruler and caliper were used to determine the length, width, flesh thickness, peel thickness, length and width of the fruit's internal cavity, and length and diameter of its seeds. In addition, the weight of the seeds was determined using a digital balance (g).

The relative leaf water content (RWC) was determined using the method of Filella *et al.* (1998). To accomplish this, 0.5 g of fresh leaves from the youngest mature leaves (FW) were extracted from each sample and replication and placed in distilled water for 24 hours. The samples were then cleaned for surface moisture and weighed once more (TW). The leaf samples were dried for 48 hours at 75 °C, and their dry weight (DW) was determined. The relative water content of the leaves was determined by the following formula:

$$RWC = (FW - DW)/(TW - DW) \times 100 \quad (1)$$

The chlorophyll index in the leaves were evaluated by employing a non-destructive method using the Minolta SPAD-502 (SPAD 502 plus, Japan) leaf chlorophyll meter. Three readings of each sample were taken in each treatment replication, and their mean was then calculated (Franco *et al.*, 1993).

The determination of proline concentrations can be assessed through the application of the ninhydrin test, as stated by Bates *et al.* as explained by Haghighi *et al.* (2022). in their seminal work published in 1973. The leaf samples were subjected to homogenization at a temperature of 4 °C, utilizing a solution of sulfosalicylic acid with a concentration of 3%. Following this, the resulting solution was subjected to incubation and centrifugation at a speed of 5000 rpm for 20 minutes. The supernatant was combined with a solution comprising ninhydrin (2.5% concentration), phosphoric acid (60% concentration, v/v), and glacial acetic acid (100% concentration, 1 mL). The absorbance was measured at a wavelength of 518 nm.

The proportion of electrolyte leakage (EL) was determined using the method of Lutts *et al.* (1996). From the plant leaves, ten one-centimeter-diameter discs were made. The samples were cleaned three times with distilled water and once with deionized water before being placed in tubes containing 10 mL of deionized water and shaken. Using a conductometer, the initial electrical conductivity (EC_1) of the solution was measured after 24 hours. The tubes were then placed in an autoclave for 20 minutes at a temperature of 120 °C. After removing the test tubes from the autoclave and bringing them to room temperature, the final electrical conductivity (EC_2) of the solutions was determined. Following this, the proportion of leaf electrolyte loss was calculated:

$$Electrolyte\ leakage\ (\%) = (EC_1 / EC_2) \times 100 \qquad (2)$$

Leaves extract is made with diluted nitric acid, potassium and sodium concentrations determined using a flame photometer (Model PFP7, Jenway, England) (Haghighi *et al.*, 2022).

To assess the firmness of the fruit, a penetrometer (model OSK-I-10,576, Ogawa Seiki Co. Ltd., Tokyo, Japan) was used to measure the skin puncture strength of fresh intact fruit. The firmness of each fruit was measured twice at equidistant points, with the two measurements taken at a 90-degree angle to each other. These values were then averaged and recorded as the firmness values in Newton (Gholamnejad *et al.*, 2023).

Total dissolved solids were measured with a refractometer (Japan K-0032 model), a small amount of juice was applied onto the lens, and the measurement was obtained in degrees Brix (◦Bx), representing the percentage of soluble solids content in the fruit. Prior to each sample, calibration was performed using distilled water, and the lens was thoroughly rinsed with distilled water twice. Utilizing the titration method and monitoring the pH of the juice, organic acids were determined and the percentage of malic acid was used to calculate the amount of titratable organic acid.

Statistical Analysis

Analysis of variance and mean's comparison were performed based on LSD tests at 1 and 5% probability levels using Statistix 8 (Tallahassee FL, USA). Biplot analysis were also done using Statgraphics Centurion, Version 18.

Second Experiment

Based on the findings from the initial experiment, which included yield cluster analysis and principal component analysis, two tolerant melon cultivars (Tork: Torkamani, Zank: Zanki) and two sensitive cultivars (G-IVA: Gorgi Ivan, G-SHI: Gorgi Shirdan Jorgeaval) were chosen and grown. The experimental design was a split-plot randomized complete block design with three replications, 2 m row spacing, and 36 m length. All cultivation, irrigation and salinity conditions were similar to the first experiment. Data were analyzed using Statistix 8 (Tallahassee FL, USA). All data were analyzed using two-way ANOVA, and significance was determined by comparing the means at $P \leq 0.05$ using the least significant difference (LSD) test.

RESULTS

The results main effects of melon types and interaction effect of salinity× melon cultivars on all measured parameters was presented in supplementary (Tables 2, 3..., 15). Also some Iranian melon landrace and Afghan melon in (Figure 2) and analyze of Cluster in (Figures 3, 4 and 5) supplementary file was showed.

The Result of the First Experiment

PCA comparisons between biochemical and morphological parameters were presented in Figures 1 and 2. The sensitive and tolerant cultivars were chosen based on proximity to high yield and improved morphological characteristics, and distance from stress indices in PCA analysis for biochemical parameters and stress indices. Additionally, we utilized ANOVA on all cultivars exposed to salinity in the supplementary file to identify the most sensitive and tolerant cultivar. For the second experiment, tolerant (Tork and Zank) and sensitive (G-IVA and G-SHI) cultivars under salinity stress were separated between all cultivars (Iranian and Afghan) for a more in-depth investigation. The biplot results showed a high correlation between vitamin C traits with soluble solids, proline, and relative water content while a negative correlation with Fv/Fm ratio. Naki Johari, Hatchke Daroneh, Ghatori, Ghandak Tanabisefid, Hatchke Johari, Talebi Tanbalemax, and Zanki are classified as salinity stress-tolerant cultivars due to their high concentration of proline, soluble solids, vitamin C, and relative leaf water content under salinity stress conditions. Furthermore, these cultivars have a strong correlation with stress resistance and the related traits.

The cluster analysis of the 18 melon cultivars based on biochemical traits produced two main clusters, including Naki Johari, Gezgi, Bandi Boyak, Hachkeh Drone, Kale Gorfi, Gorgab, Talebi Tanbalmax, Ghatori, Bargeney, Ghandake Tanabisefid, Hachkeh Johari, AbuJahl, Taki, Kalegorgi

Droneh, Zanaki, and Chini, which were classified in the first group and as stress-tolerant cultivars. The cluster analysis of the 18 melon cultivars based on morphological traits also produced three groups: Kaleh Gorgi, Hachkeh Johari, Torkamani, Gorgi Shirdan Jorjeaval, and Gezgi cultivars are morphologically more prominent in their peel than other cultivars. There are Ghatori, Gorgi Ivan, Kadoei, and AbuJahl watermelons in the second group, which are better than other cultivars in terms of spots on the peel. The biplot diagram of these traits also confirms this issue.

The Result of the Second Experiment

Fruit hardness, length, flesh thickness, and seed hole length were enhanced in Tork and Zank, particularly under control. However, neither fruit width nor cavity width differed significantly between tolerant and sensitive cultivars (Figure 3 A-F). Fruit skin thickness, seed mass weight, yield per plant, and fruit weight followed the same pattern and were greatest in Tork, followed by Zank, when compared to salinity-sensitive cultivars (G-IVA and G-SHI). Seed length and diameter were similar between Tork and Zank. Seed length was substantially greater in tolerant cultivars compared to sensitive cultivars, although seed diameter was significantly the same. In the conditions of salt stress, G-IVA had a 72% and 63% decrease in yield compared to the tolerant varieties (Tork and Zank), respectively, and in G-SHI, the yield decreased by 75% and 67% compared to Tork and Zank, respectively (Figures 4 A-F).

Vitamin C and TSS rose in all cultivars due to salt. The Zank in salinity contained the highest levels of Vitamin C. The TA content of the tolerance cultivar increased in both salinity conditions. The cultivar with the greatest TSS was tolerant of salinity. sodium increased, and potassium decreased by salinity. However, it was not statistically different by the nonsaline condition in each cultivar. The highest sodium was in G-SHI salinity, and the highest potassium Conc. was in Tork at non-saline conditions (Figures 5 A-F).

Chlorophyll fluorescence was similar across all treatments and was unaffected by cultivar. The chlorophyll index increased in the tolerance cultivar in control and it was significantly the same in Tork and Zank and G-SHI cultivar in salinity. G-IVA had the lowest Chlorophyll index in both saline conditions. RWC was greater in tolerant cultivars (Tork and Zank) in both saline conditions, but it was lower in sensitive cultivars (G-IVA and G-SHI) under salt stress. EL decreased in tolerance cultivars (Tork and Zank) and increased in sensitive cultivars (G-IVA and G-SHI) in both saline conditions. All cultivars exhibited a rise in DPPH in response to salt, with G-IVA in non-saline conditions exhibiting the lowest DPPH (Figures 6 A-F).

DISCUSSION

The Effect of Salinity on Some Morphological Parameters in a Tolerance and Sensitive Cultivar of Studied Melons

Due to a significant correlation with stress-related features such as proline and soluble solids, the relative water content of the leaf, and vitamin C, melon cultivars that are tolerant to salinity stress are ideal for field cultivation in saline soil. Turkmeni and Zenki melon cultivars based on most of the quantitative and qualitative traits investigated in this research are the most suitable for the field.

The Effect of Salinity on Yield, Chlorophyll Index, the Water Content of Tolerance and Sensitive Cultivars of Studied Melons

All characteristics reduced as salinity increased. Under salinity stress, a low fruit yield was caused by a decrease in fruit number and fruit weight, as these are the two most essential yield components. Multiple research demonstrated that melons are categorized as being relatively salt tolerant (Shannon and Francois, 1978). Dias *et al.* (2018) demonstrated that Fruit length and diameter, as well as peel and pulp thickness, decreased when subjected to EC values greater than 3.8 dSm^{-1}. Photosynthesis is the most critical physiological function of the plant, determining plant growth and yield to the greatest extent (Mobin and Khan, 2007). The growth of plants is limited by the decrease of photosynthesis. The absence of stomatal conductance, which diminishes under stress, is responsible for the decline in photosynthesis (Ashraf and Harris, 2004). The decrease in yield and fruit weight of sensitive cultivars is correlated with the expansion of the fruit's cavity and its pulp's reducing diameter. In the confirmation of these results, fruit length, fruit width, fresh weight of pulp, fresh weight of skin, fresh and dry seed weight, dry weight of 100 g pulp, and skin decreased significantly in the sensitive cultivar. As the number of epidermal cells increases, the stomata become narrower and retain cell moisture more effectively. According to Colla *et al.* (2006), the decrease in fruit yield is primarily attributable to the lower mean fruit weight in the salinity condition.

In conditions of mild stress, the chlorophyll content of a plant could increase by reducing leaf area. In other words, the rise in chlorophyll content under stress is the result of the reduction in leaf area and the thickening of cells, which causes the leaf cells to shrink (Zhou *et al.*, 2023). In contrast, high stress inhibits chlorophyll synthesis, corresponding with the findings of this experiment. The drop in SPAD value at salinity can be linked to the degradation of chloroplast structure, which reduces chlorophyll content. The chlorophyll concentration in pumpkins has been found to decrease due to salt, which aligns with our observations (Sevengor *et al.*, 2011). Due to sodium ion buildup in the leaves, chlorophyll concentration dropped (Molazem *et al.*, 2010).

In the present experiment, the cultivar with the highest and lowest relative leaf water content was determined to be the cultivar with tolerance and sensitivity, respectively. The high relative water content in stress-tolerant cultivars may be attributable to processes that limit water loss by closing the stomata or increasing water uptake through root growth (Kaya *et al.*, 2001).

The Effect of Salinity on sodium, potassium, and Tss in a Tolerance and Sensitive Cultivar of Studied Melons

By applying salinity stress, the amount of sodium in the shoot of melon increased, and the amount of sodium in the shoot was influenced. During salinity stress, the high sodium concentration in the rhizosphere and its subsequent replacement by potassium leads to a decrease in sodium content in the shoot. Under salinity stress, sodium competes with potassium and decreases the absorption of other ions, particularly potassium (Parida *et al.*, 2005). This study revealed that sensitive cultivars had the most sodium rise in response to salt stress compared to the tolerance cultivars. Increasing salinity increases sodium absorption while decreasing potassium absorption. potassium is a vital plant element, and as its concentration decreases, stomata close and photosynthesis slows, resulting in a decline in plant development (Mirmohammadi Meybodi and Ghareh yazi, 2002).

In the present study, a decrease in potassium content in salinity was detected in melons. According to Ou *et al.* (2011) and Polacik and Maricle, (2013) the most probable explanation for this controversy involves root-to-shoot nutrient translocation, species features, and duration of stress. Salt creates a 'physiological drought' by decreasing stomatal conductivity (Ou *et al.*, 2011; Polacik and Maricle, 2013), so reducing the flow of nutrients to the shoot; may result in a drop in potassium concentration with extended salinity exposure (Jackson *et al.*, 1996). Root growth is unaffected by the shock stress; this may result in a substantial uptake of potassium by the shoot (Wang and Wu, 2013).

The greatest soluble solid is found in cultivars with tolerance. The existence of a higher TSS in the salinity-tolerant cultivar may aid in maintaining osmotic control in fruits, hence preserving photosynthesis under stress, preventing a decrease in assimilate production in leaves and preventing a decrease in fruit weight. The results of this experiment prove their validity. In sensitive cultivars, salinity lowered fruit quality in terms of firmness and acidity. Melons irrigated with saline water exhibited improved fruit quality, as evidenced by a rise in TSS and a decrease in pH (Botia *et al.*, 2005).

The salinity stress treatment decreased fruit firmness relative to the control treatment. Changes in fruit tissue stiffness caused by salt stress are directly connected to cell wall composition (Sato *et al.*, 2006). Due to salt stress, calcium absorption is diminished, and calcium's involvement in cell wall strength causes fruit tissue to soften.

The Effect of Salinity on Some Stress Indices of Tolerance and Sensitive Cultivars of Studied Melons

The Fv/Fm ratio can indicate the plant's resistance to environmental pressures and the extent of its damage. Salinity stress increases variable fluorescence (Fv), maximum fluorescence (Fm), and beginning fluorescence (Fo) while decreasing photosystem II's maximal quantum performance under dark conditions (Fv/Fm) (Zhao *et al.*, 2007).

Proline was increased in tolerance melon more than in sensitive cultivars. Proline accumulation in tissues is the result of proline synthesis under stress conditions and its protection from oxidation, as demonstrated by multiple studies (Misra and Gupta, 2005). Increasing proline concentration under salt conditions may be the result of biosynthesis or a decrease in proline oxidation to glutamate conversion protein to proline. Proline concentration increased simultaneously with the decrease in leaf water content and the severity of salt stress. Given the importance of proline amino acids in moderating the harmful effects of environmental stressors, particularly salinity and osmotic control, this rise seems justifiable (Flowers *et al.*, 1977).

DPPH% increased in all melons under salinity but is greater increase was seen in tolerance cultivars. Similar to other abiotic stresses, salinity exposure induces oxidative damage via reactive oxygen species. Oxidative stress caused by salinity leads to peroxidation of membrane lipid and loss of selectivity, resulting in increased permeability of cell membranes to ions and electrolytes; thus, salinity indirectly reduces membrane cohesion and increases the percentage of ion electrolyte leakage from leaves (Wu *et al.*, 1998).

Significant increases in electrolyte leakage produced by free radical generation in a chain reaction beginning with photosynthesis were triggered by salinity (Ghoulam *et al.*, 2002). In addition, ion imbalance with salinity, particularly sodium in salinity, increases phenol content and antioxidant activity above EL %. However, a substantial correlation between sodium accumulation and EL increase was seen in the biplot test.

CONCLUSION

By enhancing osmolytes such as proline, TSS and potassium, antioxidant activity, vitamin C as a radical scavenger, and TA, the fully tolerant cultivar was able to achieve better commercial yield. It appears that melons, through osmoregulation with proline, TSS, and potassium, attempt to reduce the negative effects of saline stress, however further physiological studies are required for confirmation. So between the Afghan and Iranian genotypes tested in this experiment, Tork and Zank were advised to be grown in saline conditions because they are better than other genotypes in terms of yield traits (flesh thickness, fruit skin thickness, yield, fruit weight) and quality (vitamin C, TA and TSS). In future studies, this tolerant cultivar can be used for breeding objectives. Given that salt-tolerant cultivars exhibit better morphological traits, can yield superior quality fruit when subjected to salty conditions.

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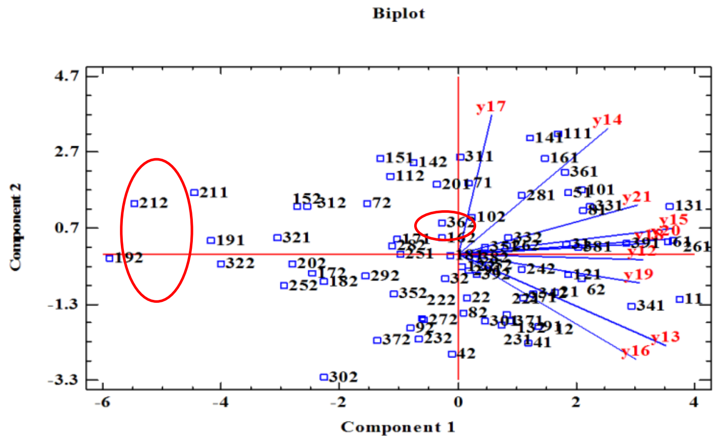


Figure 1. The scatter plot of the PC1/PC2 plane shows the relationships between the 39 studied Iranian and Afghan melon cultivars on morphological traits under saline conditions (Each number ending with 1 represents control, while each number ending with 2 represents salinity stress). The numbers correspond to the cultivars including (1): Abbasi, (2): Saderati Iran, (3): Nazokcheh Nasvari, (4): Taki Johari, (5): Gezgi, (6): Banidi Boyak, (7): Talebi Saveh, (8): Mashhadi Irani, (9): Hachke Daroneh, (10): Kale Gorgi, (11): Talebi Shahabadi, (12): Gorgab, (13): Ivanaki Zard, (14):Talebi Varamini, (15): Garmak Isfahan, (16): Bandi Siah, (17):Zardak, (18): Potk Johari, (19): Gorgi Ivan, (20): Talebi Tanbalemax, (21): Gorgi Shirdan Jorjeaval, (22):Dronak, (23): Tanabi Bandi, (24): Bandi Pizali, (25): Ghatori, (26): Torkamani, (27): Bargeney, (28): Kadoei, (29): Ghandak Tanabi sefid, (30): Hachke johari, (31): Garmak Habibabadi, (32): Hendavaneh Abujahl, (33): Mashhadi Afghani, (34): Naki, (35): Ghandak Zard, (36): Kale Gorgidoroneh, (37): Golzardak, (38): Zanki, (39):Chini, Fruit firmness (y12), Fruit length (y13), Fruit width (y14), Flesh thickness (y15) Seed cavity length (y16), Cavity width (y17), Fruit skin thickness (y18), Seed length (y19), Seed mass weight (y20), Seed diameter (y21).

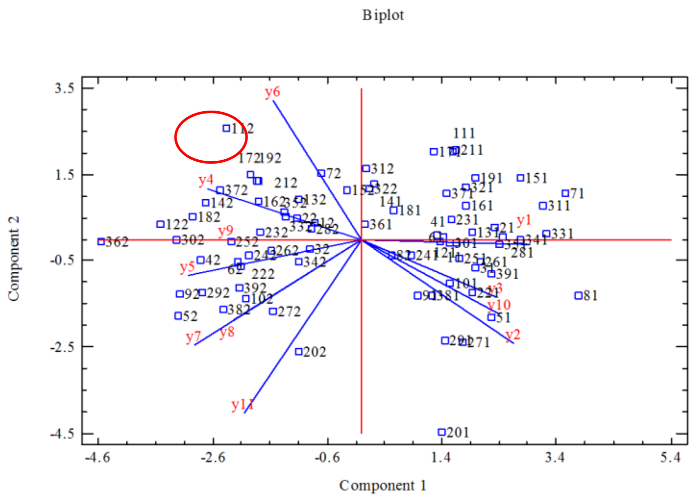


Figure 2. The scatter plot of the PC1/PC2 plane shows the relationships between the 39 studied Iranian and Afghan melon cultivars on physiological traits and some mineral elements (Each number ending with 1 represents control, while each number ending with 2 represents salinity stress) traits under saline conditions. The numbers correspond to the cultivars including (1): Abbasi, (2): Saderati Iran, (3): Nazokcheh Nasvari, (4): Taki Johari, (5): Gezgi, (6): Banidi Boyak, (7): Talebi Saveh, (8): Mashhadi Irani, (9): Hachke Daroneh, (10): Kale Gorgi, (11): Talebi Shahabadi, (12): Gorgab, (13): Ivanaki Zard, (14):Talebi Varamini, (15): Garmak Isfahan, (16): Bandi Siah, (17):Zardak, (18): Potk Johari, (19): Gorgi Ivan, (20): Talebi Tanbalemax, (21): Gorgi Shirdan Jorjeaval, (22):Dronak, (23): Tanabi Bandi, (24): Bandi Pizali, (25): Ghatori, (26): Torkamani, (27): Bargeney, (28): Kadoei, (29): Ghandak Tanabi sefid, (30): Hachke johari, (31): Garmak Habibabadi, (32): Hendavaneh Abujahl, (33): Mashhadi Afghani, (34): Naki, (35): Ghandak Zard, (36): Kale Gorgidoroneh, (37): Golzardak, (38): Zanki, (39):Chini, (y1: Chlorophyll fluorescence, y2: SPAD, y3: Relative water content, y4:Electrolite leakage ,y5: Proline, y6: DPPH, y7: Vitamin C, y8: Total acidity, y9: Sodium, y10: Potassium, y11: Total soluble solids).

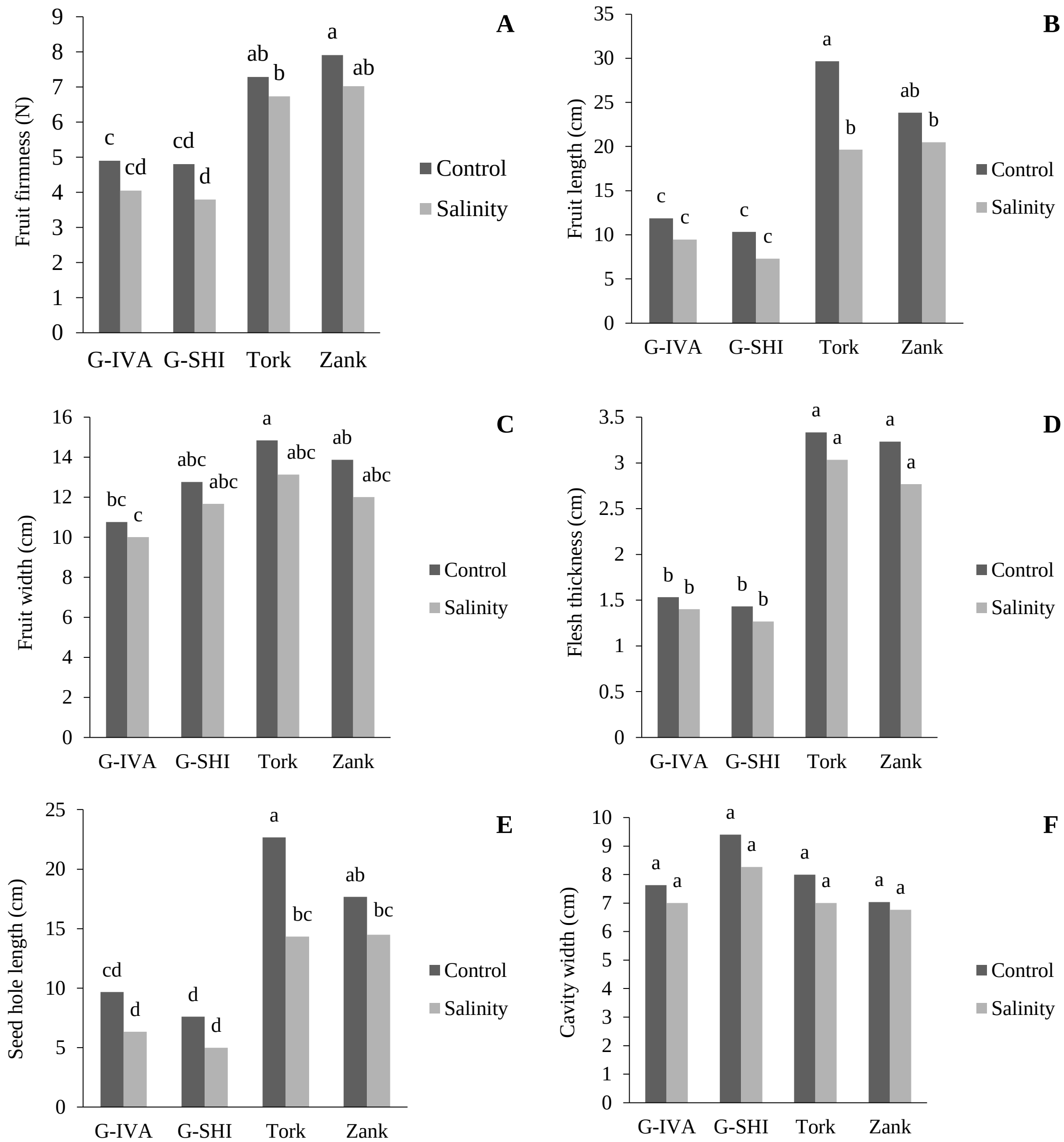
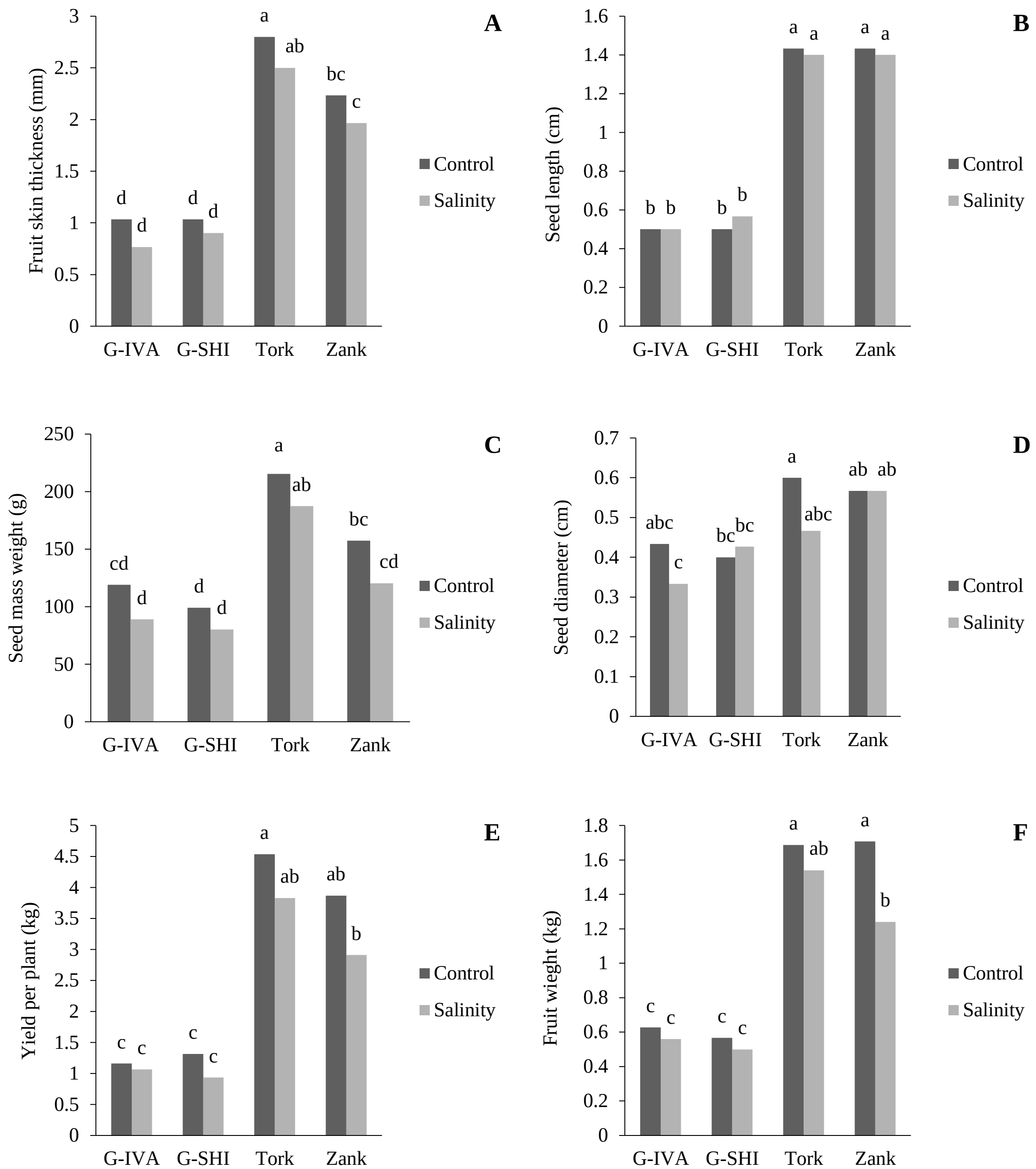


Figure 3. The effect of some morphologycal changes between tolerate (Tork and Zank) and sensitive (G-IVA and G-SHI) cultivareunder salinity stress. G-IVA: Gorgi Ivan, G-SHI: Gorgi Shirdan Jorgeaval, Tork: Torkamani, Zank: Zanki.



480 **Figure 4.** The effect of some morphological and yield parameter between tolerate (Tork and
481 Zank) and sensitive (G-IVA and G-SHI) cultivare under salinity stress. G-IVA: Gorgi Ivan, G-SHI:
482 Gorgi Shirdan Jorgeaval, Tork: Torkamani, Zank: Zanki

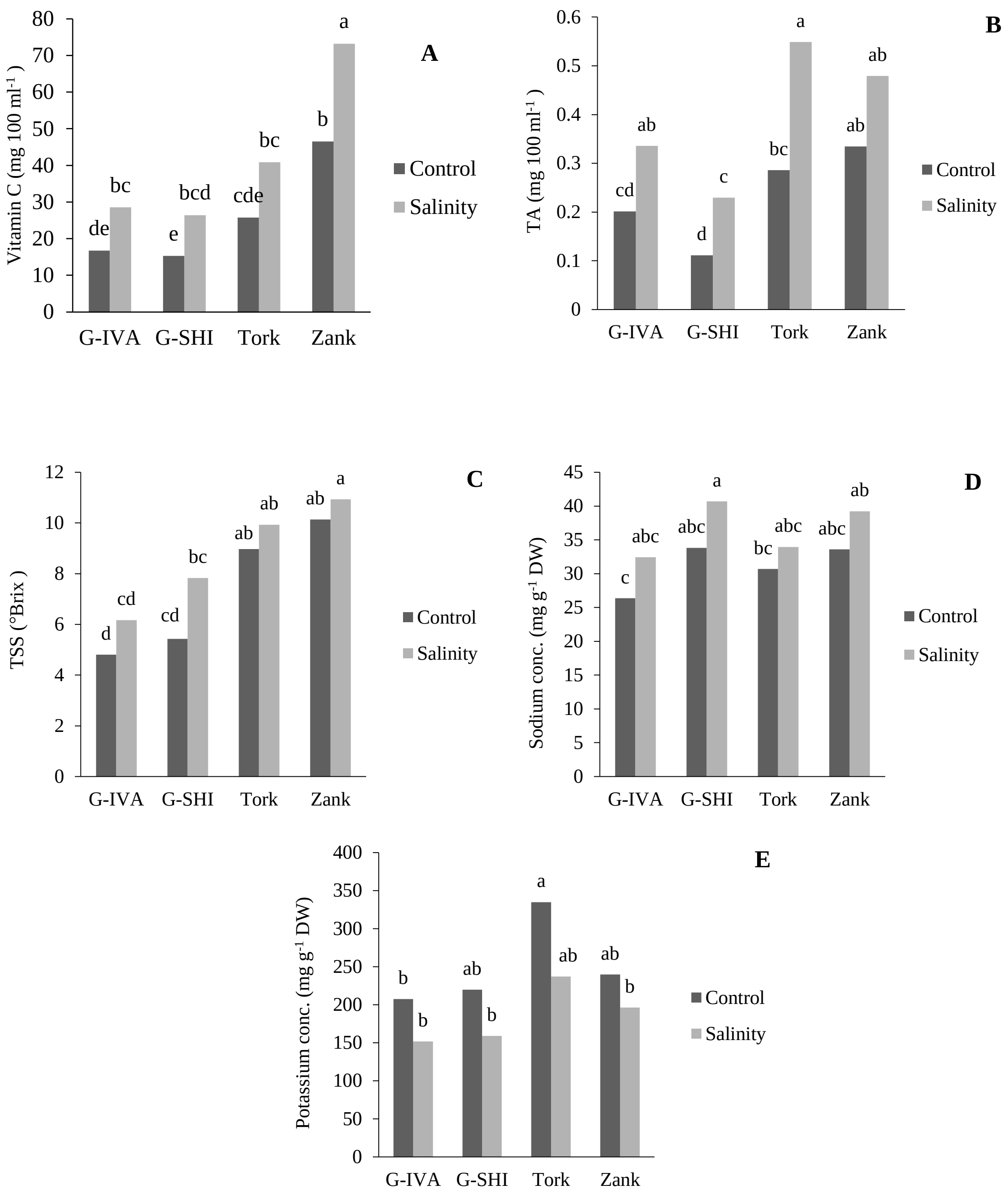


Figure 5. The effect of some qualitative changes between tolerate (Tork and Zank) and sensitive (G-IVA and G-SHI) cultivare under salinity stress. G-IVA: Gorgi Ivan, G-SHI: Gorgi Shirdan Jorgeaval, Tork: Torkamani, Zank: Zanki.

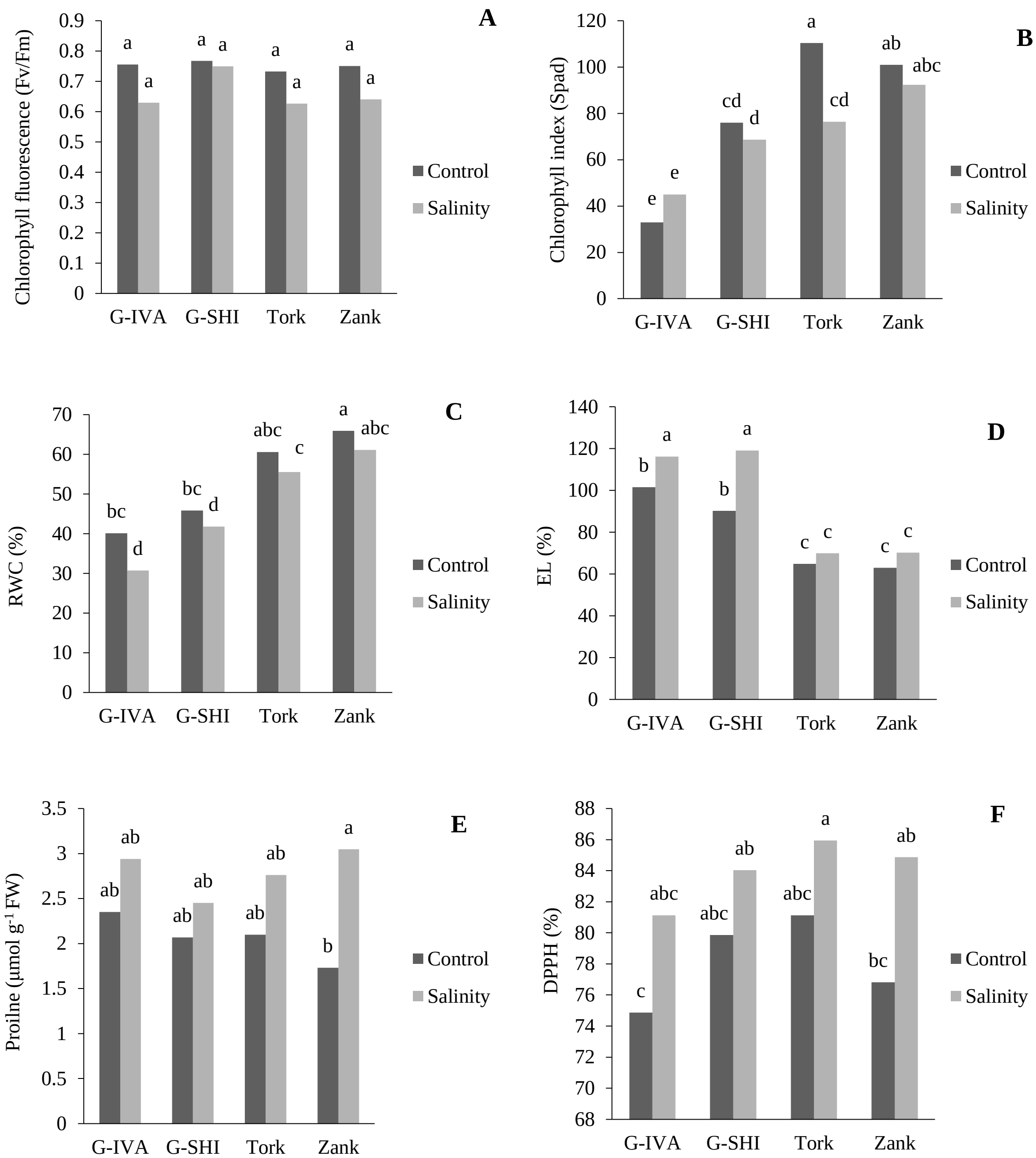


Figure 6. The effect of some stress indices changes between tolerate (Tork and Zank) and sensitive (G-IVA and G-SHI) cultivars under salinity stress. G-IVA: Gorgi Ivan, G-SHI: Gorgi Shirdan Jorgeaval, Tork: Torkamani, Zank: Zanki

غربالگری خربزه ایرانی و افغانستانی (*Cucumis melon*) در تحمل به شوری براساس برخی از صفات مورفولوژیکی و فیزیولوژیکی

ح. حکمت، م. حقیقی، ح. ر. عشقی زاده و گ. بنی طالبی

چکیده

این تحقیق به منظور بررسی اثر شوری بر برخی از صفات فیزیولوژیکی و مورفولوژیکی ارقام خربزه بومی ایرانی و افغانی در قالب طرح بلوک‌های کامل تصادفی در سه تکرار انجام شد. تیمارها شامل: دو سطح شوری (2 و 8 دسی زیمنس بر متر NaCl) و 39 رقم خربزه از ایران و افغانستان استفاده شد. مقایسه PCA بین پارامترهای بیوشیمیایی و مورفولوژیکی انجام گرفت. ارقام حساس و متحمل براساس نزدیکی به عملکرد بالا، خصوصیات مورفولوژیکی و فاصله از شاخص‌های تنش انتخاب شدند. نتایج بای پلات همبستگی بالایی بین صفات ویتامین C با مواد جامد محلول، پرولین و محتوای نسبی آب و همبستگی منفی با نسبت Fv/Fm نشان داد. این شاخص‌ها، پارامترهای خوبی برای شناسایی ارقام مقاوم به شوری هستند. تنش شوری نشت الکترولیت، غلظت پرولین، فعالیت آنتی اکسیدانی کل، محتوای سدیم، ویتامینC ، اسید آلی و کل مواد جامد محلول را افزایش داد. همچنین شوری باعث کاهش عملکرد، میانگین وزن میوه، سفتی، طول میوه، عرض میوه، طول حفره داخلی، عرض حفره داخلی، ضخامت گوشت، ضخامت پوست، نسبت Fv/Fm ، شاخص سبزی، محتوای آب نسبی و میزان پتاسیم برگ شد. بیشترین غلظت سدیم در رقم Gorgi Shirdan Jorgeaval در شرایط شور و بیشترین غلظت پتاسیم در رقم Torkamani در شرایط غیر شور مشاهده شد. بر اساس نتایج، دو نوع خربزه Torkamani و Zanki برای کاشت در شرایط شور توصیه شد.