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Drought Tolerance Levels of Turkish Melon Genetic Resources Using Morphological and Physiological Methods

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ABSTRACT

Environmental factors such as drought, resulting from global climate change, have increasingly limited productivity in melon cultivation in recent years. Turkiye's geographical location and rich genetic diversity make it highly probable that drought-tolerant genetic material exists within this diversity. In this study, 192 melon genotypes were used, sourced from the cucurbit genetic resource collection of the Department of Horticulture at Çukurova University, which includes materials from various regions of Turkiye and around the world. In the pre-screening screening phase conducted in the first year of the research, 192 genotypes were grown under drought stress conditions created using 5% PEG 6000 for two months. Parameters such as stem length, stem dry weight, root dry weight, number of leaf, and a 0-5 scale were evaluated in the green parts and roots of the plants. A general decrease was observed in all parameters except root dry weight, where a 3% increase was noted in the average of the genotypes. In the special screening phase of the study, 15 genotypes selected based on the initial screening results were subjected to a second stress test under hydroponic conditions in a climate-controlled plant growth chamber using 8% PEG 6000, parameters such as visual scale evaluation (0-5), stem fresh and dry weight, root fresh and dry weight, stem and root length, number of leaf, leaf relative water content, relative water content, and electrolyte leakage were examined. All parameters showed varying degrees of reduction in the drought-stressed genotypes compared to the control groups, except for percentage change values. An increase in electrolyte leakage was observed compared to the control. As a result of the two different screenings, the drought tolerance levels of the melon genotypes were determined. Genotype Kav-248 was identified as the most drought-tolerant, while Kav-20 was found to be the most sensitive.

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Introduction

Drought is one of the most significant environmental factors affecting agricultural production (Kuşvuran et al., 2008; Hamurcu et al., 2020). When the usable land areas worldwide are classified according to stress factors, drought stress, a natural stress factor, constitutes the largest share at 26%. In this context, drought stress is one of the most widespread environmental stresses that impact growth and yield. According to recent studies, Turkiye, among the countries at risk regarding the potential effects of global warming, along with Southern Europe, is projected to experience a significantly drier and hotter climate by 2030 (Aduse Poku at al., 2020). Given the declining capacity of natural resources to sustain the global population, millions of people could face hunger and water scarcity. Drought poses a serious threat to all life on Earth. Therefore, identifying drought-tolerant plant species, elucidating their tolerance mechanisms, and determining the factors that enhance or influence plant drought tolerance will be crucial in preventing drought from becoming a major crisis for all living beings. It is well known that cultivated plants possess genotypes with varying levels of tolerance to abiotic stress conditions such as drought and salinity. However, the insufficient tolerance levels of the genotypes commonly used in plant production to these stress conditions negatively affect many metabolic processes, resulting in crop quality and yield losses.

Melon is significant in agricultural production and human nutrition with a global production of 29.5 million tons on approximately 1,092,354 hectares. Turkiye, producing 1,403,214 tons of melons, ranks among the world's leading melon-producing countries (FAO, 2023). China is the world's largest producer of melons, while Turkiye ranks second place. Environmental factors, such as drought caused by global climate change, have led to a decline in melon yield in recent years. Although certain cultural practices can help mitigate these stress factors,

they are often limited, costly, and time-consuming. In this regard, developing drought-tolerant varieties is a more sustainable long-term solution. Melon cultivation, particularly in arid and semi-arid regions, can facilitate the more effective utilization of these areas, especially through the identification of drought-tolerant genotypes. Turkiye lies within the secondary genetic diversity region of melons, making it highly likely that drought-tolerant genetic material exists within this rich genetic pool (Kusvuran, 2010).

Comparative genomic and transcriptomic studies, understanding the roles of miRNAs in plant drought stress responses, elucidating the mechanisms of drought-tolerant wild genotypes, and uncovering the role of epigenetics in plant stress adaptation are among the key priorities. Integrating this knowledge with classical breeding efforts is the most critical step in developing plants tolerant to multiple abiotic stress conditions found in nature (Öztürk, 2015). A comprehensive understanding of these mechanisms can enhance the value of bred plants capable of thriving under stress conditions. Using genotypes adapted to arid conditions is a primary criterion for breeding efforts (Akashi et al., 2005; Karipçin et al., 2009; Hamurcu et al., 2020). Therefore, our research aims to determine the drought tolerance levels of the melon genotypes used in our study through morphological and physiological methods.

Materials and Methods

A total of 192 melon genotypes selected from a collection established by the Department of Horticulture at the Faculty of Agriculture, Çukurova University, since 1989, were used. These genotypes were sourced from various regions of Turkiye and around the world. A two-stage drought tolerance screening was conducted. In the first stage, the pre-screening, all 192 melon genotypes were evaluated. Based on the results of the assessed parameters, a selection was made for the second stage, the special screening. The pre-screening of the 192 melon genotypes was carried out in climate-controlled greenhouses (during the experiment, temperature, solar intensity and relative humidity inside the greenhouse were maintained at 25 ± 3°C, 1750 ±50 kcal/m^2 and 60 ± 10%, respectively) at the Faculty of Agriculture, Selçuk University, where their drought tolerance levels were determined.

The melon seeds used in the experiment were first treated with sodium hypochlorite, followed by 75% ethanol, and then rinsed with sterile distilled water to complete surface sterilization.

The sterilized seeds were soaked in pure water for 4-5 hours and then planted in 300 ml pots filled with perlite, without drainage.

Measurements and Observations in the Pre-screening Screening Stage

In the study, 192 melon genotypes (Torun, 2017) were used and divided into two groups (control and drought), with four replications and three pots per replication, totaling 4,608 pots. To create drought conditions, when the plants reached the 3-4 true leaf stage, a 5% concentration of PEG 6000 was added to the nutrient solution and applied to the plants.

Determination of Seedling Weight, Height, and Leaf Number

Approximately 3 weeks after inducing drought stress in the melon seedlings, when the plants reached the 8-9 leaf stage (Fig. 1), four randomly selected seedlings from both the control and drought treatments were divided into root and shoot tissues. Each part was weighed separately on a precision digital scale (accurate to 1/10,000) to determine fresh weight (g) and the number of true leaves. During these measurements, the stem length of each plant was also measured using a ruler and recorded in centimeters. The samples were dried in an oven set at 70°C for 48 hours to obtain dry weight values and then weighed again to determine their dry weights (g).

Determination of Drought Tolerance Levels Using a 0-5 Scale

In the drought tolerance experiment, scores ranging from 0 to 5 were assigned according to Kuşvuran (2010).

Evaluation of Pre-screening Screening Data

The "Weighted Rating" method was used to evaluate the data obtained from both the pre-screening and special screening stages of the research (Türkmen et al., 2005; Serçe & Görgülü, 2009).

In the pre-screening screening phase, the criteria used for weighted rating included leaf number, stem length, stem dry weight, root dry weight, and the 0-5 scale. The percentage losses in these traits under drought stress conditions were calculated relative to the control treatment (Torun, 2017).

Measurements and Observations in the Special Screening Stage

The results of the pre-screening screening phase were evaluated, and 15 drought-tolerant and sensitive melon genotypes were selected from the genotypes used. A detailed screening study was then conducted on these selected genotypes.

Preparation of Experimental Series

The melon genotypes used as research material were grown under controlled conditions in a hydroponic system within a climate-controlled chamber. In the climate chamber, the seeds of the research plants were germinated, and the young seedlings were grown under controlled conditions with the following parameters: 45-55% humidity, a photoperiod of 16 hours light and 8 hours darkness, a temperature of 21±1°C, and a light intensity of 16,000 Lux/Day.

The seeds of the melon genotypes used in the experiment were first treated with sodium hypochlorite and then with 75% ethanol, followed by rinsing with sterile distilled water to complete surface sterilization. The sterilized seeds were soaked in pure water for 4-5 hours. After three days of germination in the dark at 22°C, the seedlings were grown in sterilized pots containing a 1/5x diluted Hoagland solution (control).

In the study, drought groups were created alongside the control group (Hoagland solution), adding an 8% concentration of PEG 6000 solution to the Hoagland solution. The experiment was set up with 4 replications, and each replication included 10 plants.

Growth Parameters

Approximately 3-4 weeks after sowing, when the plants reached the 6-7 leaf stage, plant samples were collected, and their roots and shoots were separated. The lengths of the roots and shoots were measured, and their fresh and dry weights were recorded. Drought tolerance levels were determined using a 0-5 scale. The samples were dried in an oven at 70°C for 72 hours, after which their dry weights were determined.

Relative Water Content

During the sampling periods, 6 leaf samples were taken from the youngest shoots of each group (from 6 different plants), and their fresh weights were measured. The leaf samples were placed in Petri dishes filled with deionized water (dI-H_2O) for 6 hours to allow them to reach full turgor. After drying in an oven at 70°C for 72 hours, their dry weights were determined. The relative water content (RWC) of the leaf samples for each group was calculated as a percentage using the following formula:

$$RWC\ (\%) = [(FW - DW) / (TW - DW)] \times 100$$

Where:
FW =Fresh Weight
DW=Dry Weight
TW =Turgid Weight

Leaf Water Potential Measurements (bar)

The leaf water potential measurements of the genotypes subjected to drought tolerance tests were carried out using a Pressure Chamber device.

Cell Membrane Permeability (Electrolyte Leakage)

Cell membrane permeability, measured as electrolyte leakage, was determined according to the method described by Dionisio-Sese and Tobita (1998).

Weighted Rating Calculations in the Special Screening Experiment

In the special screening experiment, the following traits were used as the basis for weighted rating: stem length, stem dry weight, stem fresh weight, root length, root dry weight, root fresh weight, leaf number, leaf water potential, relative water content (RWC), electrolyte conductivity (EC), and the 0-5 scale. Like the pre-screening screening, the percentage losses in these traits under drought stress conditions were calculated relative to the control treatment (Torun, 2017).

Results and Discussion

Measurements were taken for stem length, stem dry weight, root dry weight, and leaf number in both the shoots and roots of the drought-stressed and control group melon genotypes. A general decrease in the dry weight of the shoots was observed in drought-treated plants compared to the control plants. Comparing the genotypes under the same stress conditions with their respective controls, the percentage changes were found to better reflect the degree of impact of drought stress on the genotypes. The percentage decreases, and increases were determined.

In the pre-screening screening phase, the stem lengths of the 192 genotypes ranged from 8.33 to 21.67 cm in the control group and from 6.33 to 15.67 cm in the drought-treated group. The stem dry weight values ranged from 0.62 to 2.30 g in the control group and from 0.30 to 1.50 g in the drought-treated group. The root dry weight measurements ranged from 0.13 to 0.59 g in the control group, while in the drought-stressed group, they varied between 0.09 and 0.67 g. It was observed that melon plants grown under stress conditions produced fewer leaves than control plants. The leaf count in the control group ranged from 5 to 13 leaves, while in the drought-treated group, it varied between 3.33 and 12.00 leaves (Torun, 2017).

Additionally, the total weighed rating scores of 192 melon genotypes used in the pre-screening screening stage were calculated (Table 1).

Plant growth is significantly affected under drought conditions, with the extent of the impact depending on the duration of water scarcity. In the early stages of drought, plants slow down stem elongation and promote root development to access more water. However, if drought conditions persist long enough to cause damage, both stem and root growth cease, leaf area and leaf number decrease, and some leaves may even turn yellow and fall off. The reduction in plant growth is attributed to the cessation of cell division and expansion in the shoot and root meristems (Anjum et al., 2011; Öztürk, 2015). These findings support the results of our research.

When the 192 melon genotypes used in the study were evaluated according to the 0-5 scale (Karipçin 2009, Kuşvuran 2010, Mukeshimana et al. 2014), the following distribution was observed:

- 1-point group: 11 genotypes
- 2-point group: 12 genotypes
- 3-point group: 52 genotypes
- 4-point group: 88 genotypes
- 5-point group: 29 genotypes (with average scores ranging between 4.25 and 4.75 across four replications)

It was determined that most of the genotypes fell within the 2-point and 4-point groups.

Among the 192 genotypes:

Kav 173, Kav 20, and Kav 193 were identified as the top three genotypes most severely affected by stress, with an average score of 4.75. Figure 1 shows the drought tolerance stages of some melon genotypes.

- Kav 113, Kav 116, and Kav 16 were identified as the three genotypes least affected by stress, with a score of 1.

Changes in growth parameters of plants under drought stress in the special screening experiment, in the special screening phase, the genotypes selected based on the pre-screening screening results were evaluated according to all parameters. A total of 15 genotypes—both drought-tolerant and sensitive (Kav 8, Kav 265, Kav 267, Kav 231, Kav 62, Kav 190, Kav 204, Kav 257, Kav 183, Kav 28, Kav 210, Kav 248, Kav 70, Kav 20, Kav 188)—were screened under hydroponic conditions in a climate-controlled plant growth chamber (Figure 2, Figure 15). And as in the pre-screening, weighted rating scores of the data obtained in the special screening experiment were calculated (Figure 15, Table 2).

Table 1. Total Weighed rating scores and drought stress tolerance levels of melon genotypes at the pre-screening screening stage

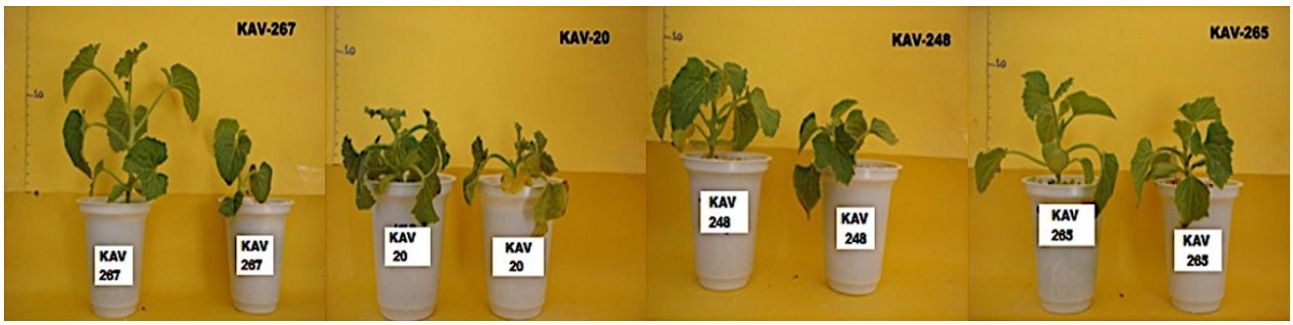
Tolerance Level											
Tolerant				Moderate				Intolerant			
G	P	G	P	G	P	G	P	G	P	G	P
Kav 265	570	Kav 72	425	Kav 84	385	Kav 16	340	Kav 70	305	Kav 148	245
Kav 138	555	Kav 285	425	Kav 193	385	Kav 13	340	Kav 56	305	Kav 5	245
Kav 8	550	Kav 6	425	Kav 90	380	Kav 221	340	Kav 179	305	Kav 26	240
Kav 280	515	Kav 51	420	Kav 170	380	Kav 278	340	Kav 133	300	Kav 69	240
Kav 59	515	Kav 88	415	Kav 228	380	Kav 241	340	Kav 24	300	Kav 82	235
Kav 226	505	Kav 258	415	Kav 270	380	Kav 288	340	Kav 189	300	Kav 252	235
Kav 99	505	Kav 32	410	Kav 209	380	Kav 33	340	Kav 41	300	Kav 276	235
Kav 79	505	Kav 137	410	Kav 64	380	Kav 9	340	Kav 87	300	Kav 102	230
Kav 248	500	Kav 281	410	Kav 282	375	Kav 43	340	Kav 263	295	Kav 107	230
Kav 190	500	Kav 1	405	Kav 36	375	Kav 35	330	Kav 211	295	Kav 223	230
Kav 62	485	Kav 219	405	Kav 230	375	Kav 191	330	Kav 105	290	Kav 187	230
Kav 272	480	Kav 284	405	Kav 39	375	Kav 85	330	Kav 217	290	Kav 174	225
Kav 23	475	Kav 218	405	Kav 73	375	Kav 186	325	Kav 171	290	Kav 86	225
Kav 22	470	Kav 48	405	Kav 173	375	Kav 234	325	Kav 97	290	Kav 277	225
Kav 49	460	Kav 46	405	Kav 27	375	Kav 30	325	Kav 240	290	Kav 176	220
Kav 18	460	Kav 268	400	Kav 235	375	Kav 212	325	Kav 96	285	Kav 194	210
Kav 65	460	Kav 42	400	Kav 50	375	Kav 10	325	Kav 229	285	Kav 109	210
Kav 21	455	Kav 214	400	Kav 183	375	Kav 256	325	Kav 236	285	Kav 231	205
Kav 28	455	Kav 233	400	Kav 127	370	Kav 290	325	Kav 44	285	Kav 68	205
Kav 210	455	Kav 287	395	Kav 126	370	Kav 243	320	Kav 54	285	Kav 4	205
Kav 255	450	Kav 124	395	Kav 232	370	Kav 259	320	Kav 247	285	Kav 52	205
Kav 249	450	Kav 11	395	Kav 2	370	Kav 45	320	Kav 257	285	Kav 113	180
Kav 246	450	Kav 238	395	Kav 25	365	Kav 208	320	Kav 262	280	Kav 63	180
Kav 19	445	Kav 168	395	Kav 213	365	Kav 273	315	Kav 198	275	Kav 264	180
Kav 271	445	Kav 3	395	Kav 175	360	Kav 185	310	Kav 12	275	Kav 204	165
Kav 275	440	Kav 37	395	Kav 269	360	Kav 40	310	Kav 67	275	Kav 55	165
Kav 66	440	Kav 169	395	Kav 17	360	Kav 254	310	Kav 130	270	Kav 61	160
Kav 60	440	Kav 237	395	Kav 242	355	Kav 7	310	Kav 294	270	Kav 267	140
Kav 29	435	Kav 279	390	Kav 251	355	Kav 20	310	Kav 266	270		
Kav 283	435	Kav 106	390	Kav 250	355			Kav 274	265		
Kav 239	435	Kav 197	390	Kav 261	350			Kav 15	265		
Kav 225	430	Kav 83	390	Kav 180	345			Kav 47	265		
Kav 216	430			Kav 215	345			Kav 53	260		
Kav 286	430			Kav 149	345			Kav 116	250		
								Kav 245	250		

G: Genotypes; P: Points

Table 2. Weighted Rating Scores of the data obtained in the special screening experiment

G	RWC	EC	LWP	LC	SDW	SFW	RDW	RFW	SL	RL	S	T
Kav 8	20	15	80	15	40	30	30	30	10	10	30	310
Kav 20	10	5	40	10	20	20	20	20	25	15	15	200
Kav 28	10	15	40	25	40	50	20	20	25	15	30	290
Kav 62	15	15	80	20	30	20	30	30	15	15	45	315
Kav 70	10	5	60	10	10	10	10	10	10	15	45	195
Kav 183	10	15	60	5	20	10	40	40	5	20	30	255
Kav 188	15	5	80	25	20	30	40	50	10	20	45	340
Kav 190	15	20	80	15	30	20	30	30	10	5	45	300
Kav 204	20	10	60	20	20	40	40	40	15	15	30	310
Kav 210	10	20	40	15	40	50	40	40	20	20	45	340
Kav 231	20	10	40	20	30	40	20	30	15	10	30	265
Kav 248	25	25	100	25	50	50	50	50	25	25	60	485
Kav 257	15	10	80	5	20	20	50	50	15	20	30	315
Kav 265	20	15	100	25	50	50	50	50	25	25	75	485
Kav 267	5	5	20	15	20	10	30	30	20	10	15	180

G: Genotype; LWP: Leaf Water Potential; LC: Leaf Count; SDW: Stem Dry Weight; SFW: Stem Fresh Weight; RDW: Root Dry Weight; RFW: Root Fresh Weight; SL: Stem Length (cm); RL: Root Length (cm); S: 0-5 Scale; T: Total



Sensitive Tolerant

Figure 1. Comparison of drought sensitive and tolerant genotypes compared to control at the pre-screening screening stage

Figure 2. Growth stages of melon genotypes in the climate chamber during the special screening phase

Figure 3. Melon seedlings at the end of 72 hours in the special screening phase in the climate chamber, A: KAV 20 genotype control and 72 hours, B: KAV248 genotype control and 72 hours

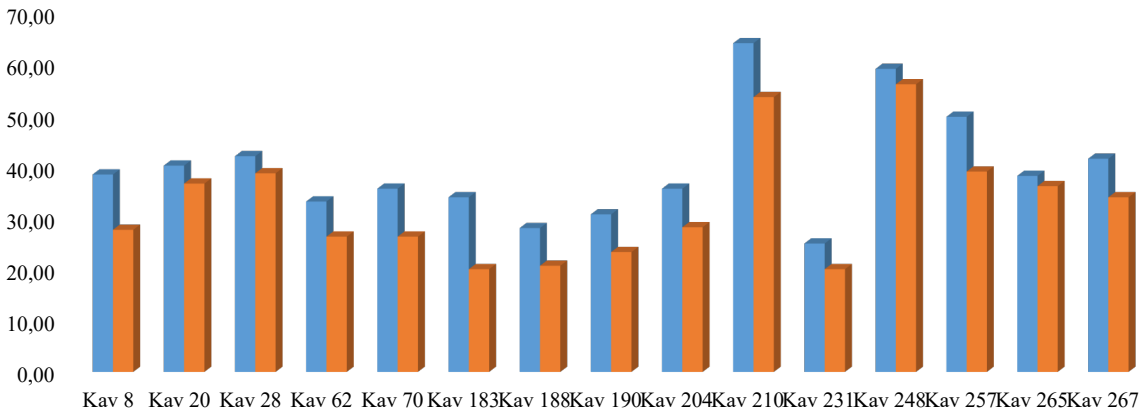


Figure 4. Changes in stem length (cm) values in plants under drought stress, X: Genotypes, Y: stem length, Blue lines: Control, Red lines: Drought stress

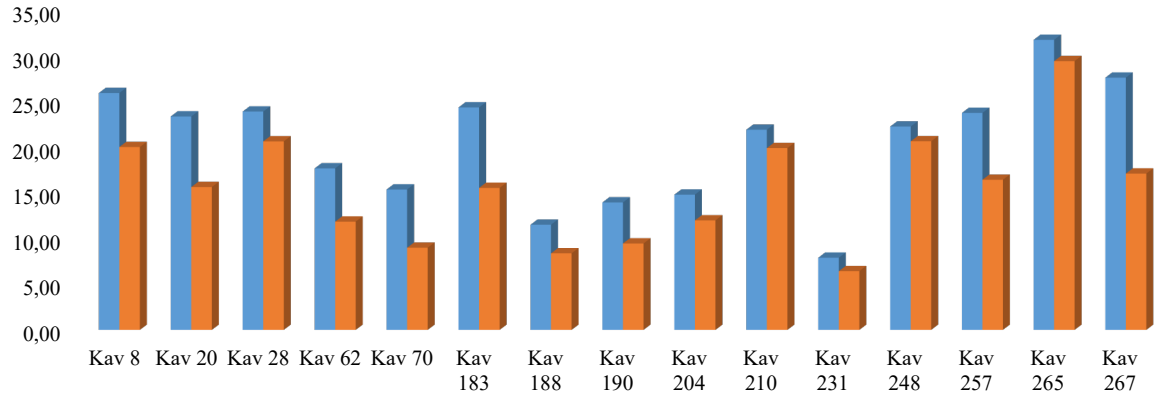


Figure 5. Changes in stem fresh weight (g) values in plants under drought stress, X: Genotypes. Y: stem fresh weight, Blue lines: Control, Red lines: Drought stress

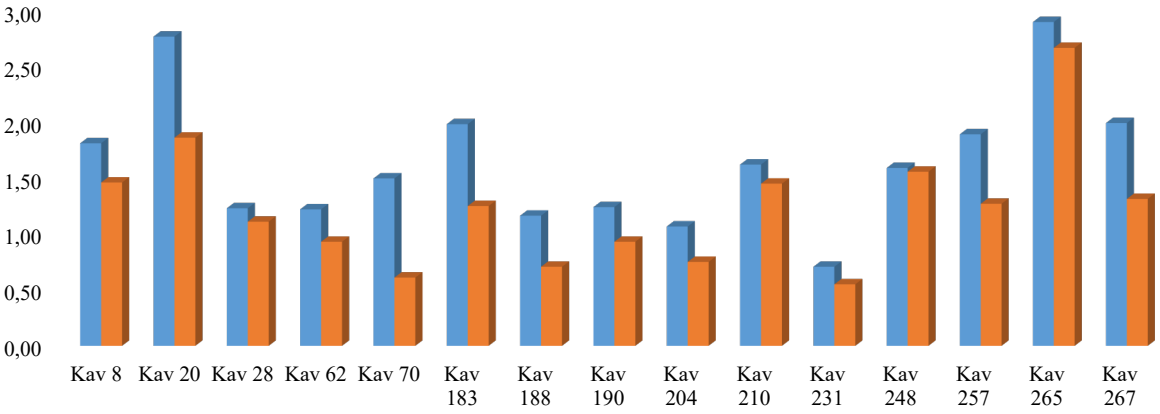


Figure 6. Changes in stem dry weight (g) values in plants under drought stress, X: Genotypes, Y: stem dry weight, Blue lines: Control, Red lines: Drought stress

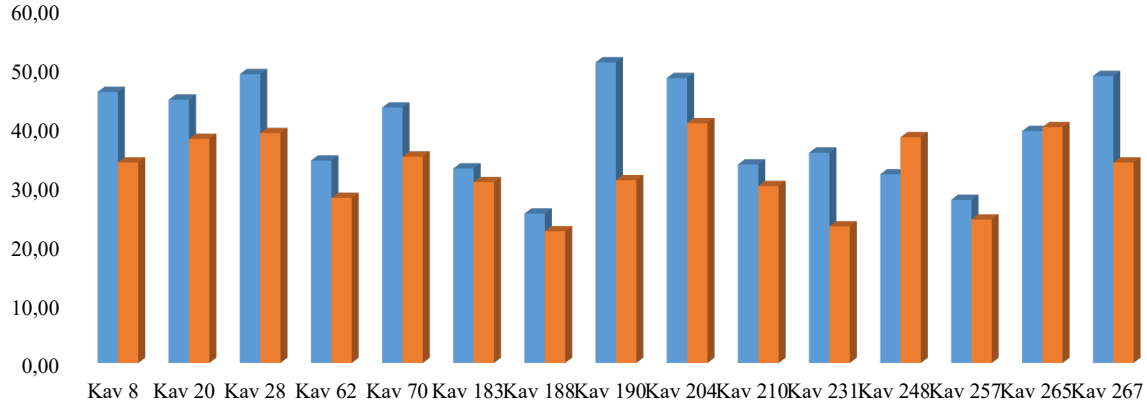


Figure 7. Changes in root length (cm) values in plants under drought stress, X: Genotypes, Y: root length, Blue lines: Control, Red lines: Drought stress

When the stem length values of the 15 genotypes used in the special screening experiment were compared to the control group, the highest reduction under drought conditions was observed in the Kav 183 genotype, with a 41% decrease. The Kav 248 and Kav 265 genotypes showed a 5% reduction, while the Kav 28 and Kav 20 genotypes exhibited reductions of 8% and 9%, respectively. Images of the stem lengths of the Kav 20 and Kav 248 genotypes from the special screening phase are provided in Figure 4.

Regarding the stem fresh weight values of the genotypes, the highest in the control group was 31.77 g, obtained from the Kav 265 genotype, followed by the Kav 267, Kav 8, and Kav 183 genotypes. The lowest stem fresh weight value was 7.90 g, recorded in the Kav 231 genotype. In the drought-treated group, the Kav 265 genotype again had the highest stem fresh weight at 29.44 g, while the lowest value was 6.43 g in the Kav 231 genotype. The percentage changes compared to the control ranged from -41% to -7%.

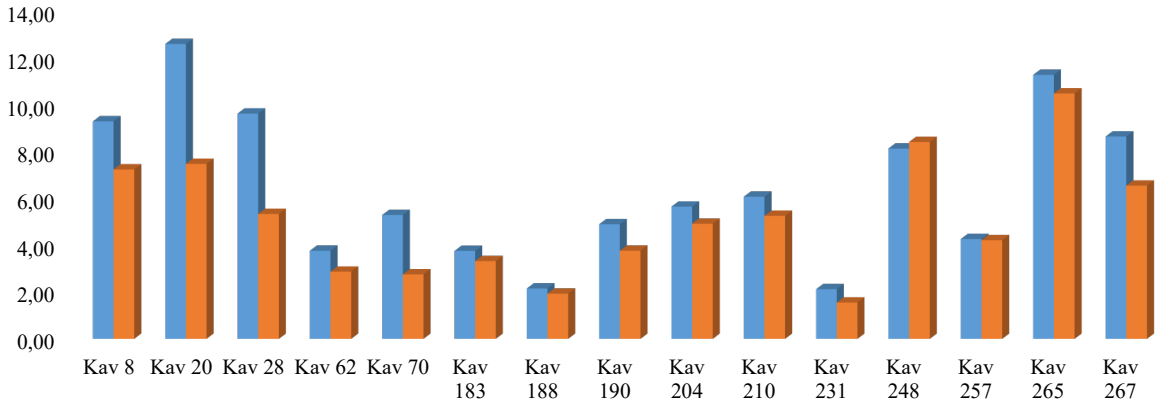


Figure 8. Changes in root fresh weight (g) values in plants under drought stress, X: Genotypes, Y: root fresh weight, Blue lines: Control, Red lines: Drought stress

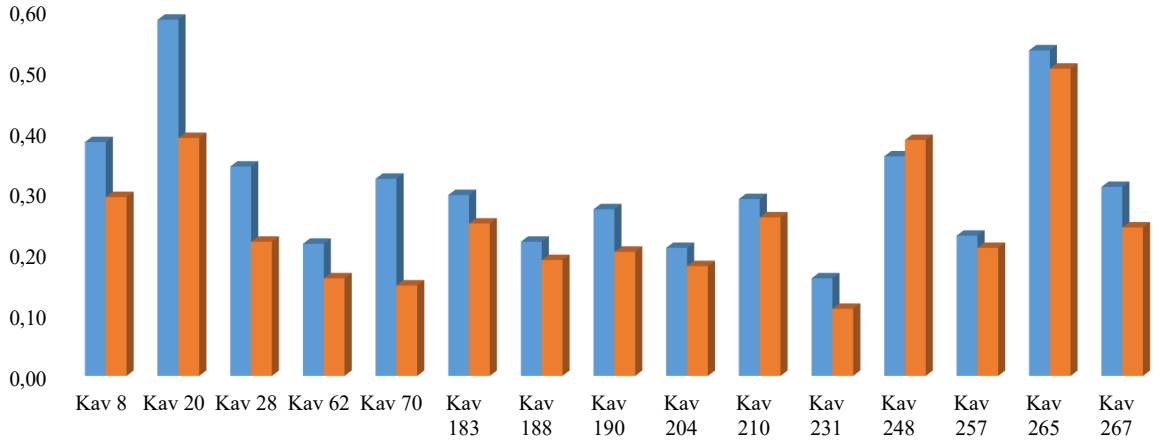


Figure 9. Changes in root dry weight (g) values in plants under drought stress, X: Genotypes, Y: stem dry weight, Blue lines: Control, Red lines: Drought stress

The greatest changes were observed in the Kav 70, Kav 267, and Kav 183 genotypes, while the lowest percentage change was a 7% reduction in the Kav 265 and Kav 248 genotypes (Figure 5).

Similar to the reductions in stem fresh weight, the stem dry weights of plants exposed to drought stress also decreased. The Kav 248 genotype, which showed only a 2% reduction compared to the control, was the least affected in this parameter. The reduction rates in stem dry weight among the genotypes ranged from 1% to 59%. The highest reduction in dry weight (59%) was observed in the Kav 70 genotype, decreasing from 1.5 g to 0.61 g (Figure 6).

Under drought stress conditions, the most significant reduction in root length compared to the control was 39% in the Kav 190 genotype. In contrast, the Kav 248 and Kav 265 genotypes showed increases of 20% and 2%, respectively (Figure 7). When comparing the root fresh weight values of the genotypes to the control, increases were observed in the Kav 248 and Kav 265 genotypes, while the Kav 70 genotype exhibited a 48% reduction (Figure 8). Regarding root dry weight, the Kav 248 genotype showed a 7% increase compared to the control, while the Kav 70 genotype experienced a 54% reduction (Figure 9).

In the special screening phase of the study, the first noticeable symptomatic effect of drought stress, induced by the application of 8% PEG 6000, appeared on the leaves of the 15 melon genotypes. This was followed by yellowing and necrosis starting from the older leaves, drying and shedding of leaves, reduction in leaf number, restricted growth, and eventually plant death (Figure 3).

When evaluating the leaf numbers of the melon genotypes, the highest leaf counts in the control groups were observed in the Kav 257 and Kav 248 genotypes, while the lowest was recorded in the Kav 62 genotype. Under drought stress conditions, the highest leaf count was observed in the Kav 248 genotype, while the lowest leaf counts were seen in the Kav 62 and Kav 70 genotypes. The Kav 62 genotype had the lowest average leaf count under stress conditions, with a value of 4.67 (Figure 10).

An increase in electrolyte leakage (EC) values was observed in all genotypes compared to the control. The Kav 20 and Kav 188 genotypes showed 65% and 68%, respectively, while the smallest increase of 15% was detected in the Kav 248 genotype (Figure 11). The increase in electrolyte leakage due to drought stress indicates a disruption in membrane stability and is often used as an indicator of drought tolerance in leaves (Martin et al., 1987).

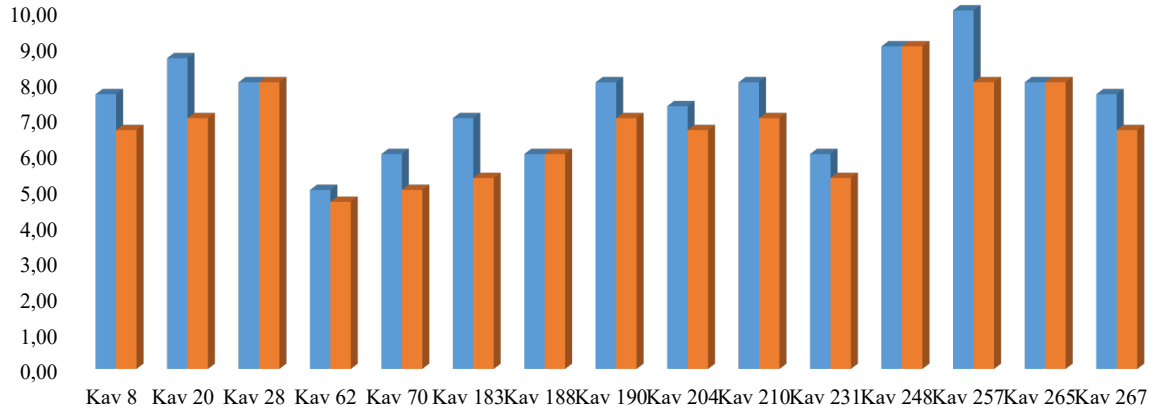


Figure 10. Changes in leaf number values in plants under drought stress, X: Genotypes. Y: leaf number, Blue lines: Control, Red lines: Drought stress

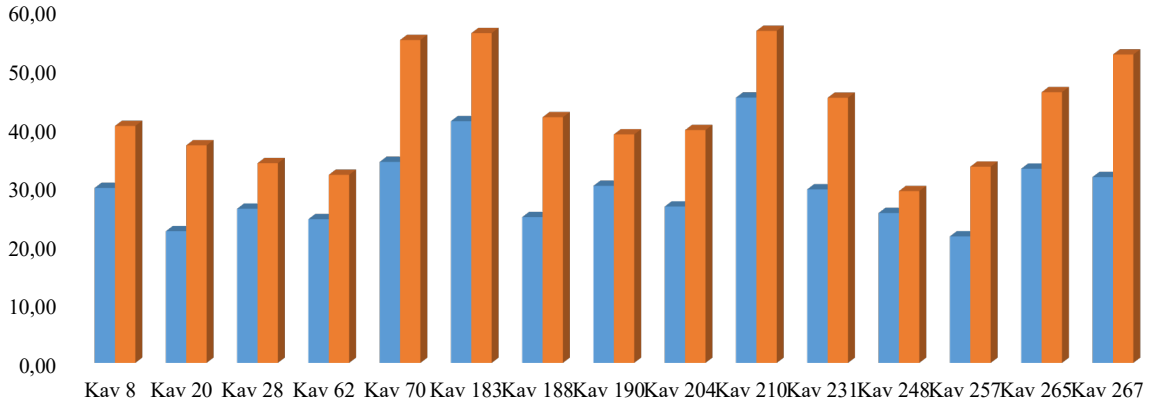


Figure 11. Changes in EC values (%) in plants under drought stress, X: Genotypes, Y: EC values, Blue lines: Control, Red lines: Drought stress

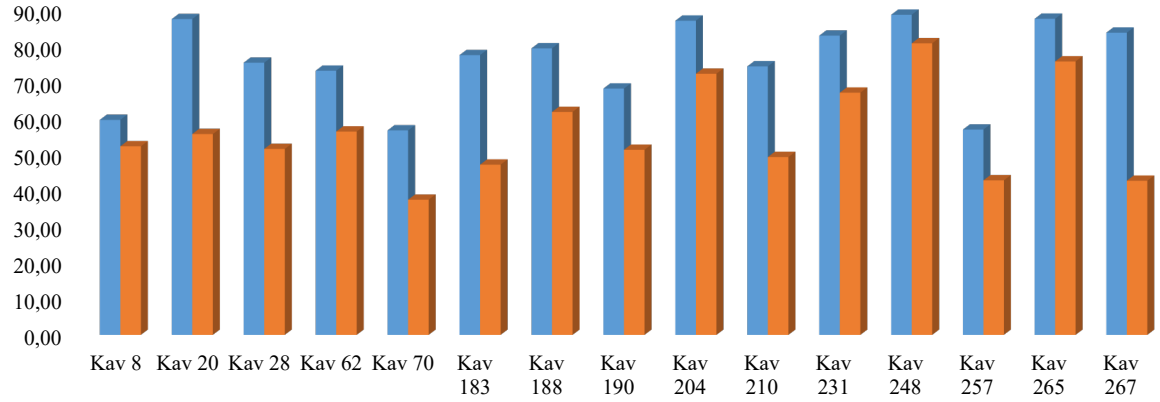


Figure 12. Changes in RWC values in plants under drought stress, X: Genotypes, Y: RWC values, Blue lines: Control, Red lines: Drought stress

The rise in electrolyte leakage is a sign of damage to biological membranes exposed to oxidative stress (Munné-Bosch and Peñuelas, 2003). Such changes are primarily caused by increased production of reactive oxygen species (ROS), particularly the accumulation of H_2O_2, which has a longer lifespan than other ROS (Apel and Hirt, 2004).

When examining the Relative Water Content (RWC) values of the 15 genotypes used in the special screening phase, a decrease was observed in the leaves of all genotypes compared to the control. The percentage change values of the drought-stressed group relative to the control group ranged from 49% (Kav 267) to 9% (Kav 248). In the stressed group, the genotype with the highest RWC value, proportional to the reduction, was Kav 248 at 80.41%, while the lowest value was 37.30% in the Kav 70 genotype. A graph showing the percentage changes, application results, and differences among the genotypes is provided in Figure 12.

In the special screening phase conducted in a climate-controlled chamber under hydroponic conditions, a general decrease in leaf water potential values was observed compared to the control.

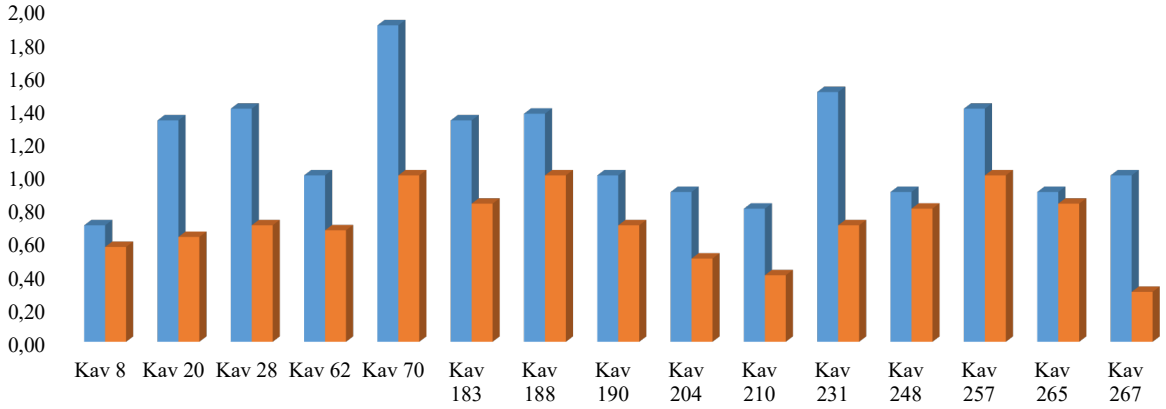


Figure 13. Changes in leaf water potential values in plants under drought stress, X: Genotypes, Y: LWP values, Blue lines: Control, Red lines: Drought stress

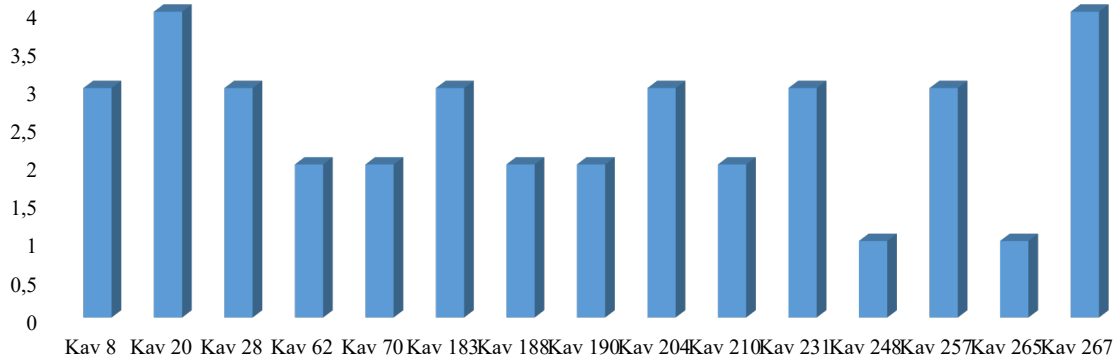


Figure 14. Changes in 0-5 scale values in plants under drought stress, X: Genotypes, Y: 0-5 scale values

When examining the percentage change rates of the drought-stressed group relative to the control group, the genotype showing the highest change was Kav 267 with a 70% reduction. In comparison, the genotypes showing the least change were Kav 265, with an 8% reduction, and Kav 248, with an 11% reduction. The highest leaf water potential measured in the control plants was 1.90 MPa in the Kav 70 genotype, while the lowest leaf water potential in the drought-stressed group was 0.30 MPa in the Kav 267 genotype. A graph showing the percentage changes, application results, and differences among the genotypes is provided in Figure 13.

When evaluating the 0-5 scale values of the 15 genotypes used in the special screening phase of our study, the Kav 248 and Kav 265 genotypes scored 1 (one) point, indicating that they were the least visually affected by drought stress. In contrast, the Kav 20 and Kav 267 genotypes scored 4 points, indicating they were the most affected. Figure 14 provides a graph showing the percentage changes, application results, and differences among the genotypes.

In a study investigating genotypic differences in drought tolerance among melon genotypes, 30 different genotypes, and the Galia F1 variety were used. When the plants reached the 3-4 true leaf stage, watering was completely stopped for the stressed group, while the control plants continued to be watered. After 14 days, once stress symptoms appeared, the effects were evaluated using a 0-5 visual scale, and measurements were taken for fresh and dry weight of the green parts, stem length and diameter, leaf number and area, leaf relative water content, and membrane damage index. At the end of the study, it was concluded that melon genotypes exhibited a wide variation in drought tolerance and that the examined parameters could be effectively used to determine drought tolerance (Kuşvuran and Abak, 2012). Kulkarni and Deshpande (2007) screened tomato genotypes under *in vitro* conditions using polyethylene glycol (PEG) to determine drought resistance and found that drought-sensitive varieties had shorter stem and root lengths. Türkan et al. (2005) reported that leaves were the most affected organs under drought conditions, while Costa Franço et al. (2000) stated that root growth and development were also significantly impacted by drought. The data obtained from our research are also similar to the studies of Rehman et al. (2024), Rehman et al. (2023), Akhoundnejad and Daşgan (2019).

Conclusion

Melon, which exhibits moderate tolerance to drought, is cultivated in many regions of Turkiye where drought is a potential issue. Environmental factors such as drought, resulting from global climate change, have led to a decline in melon yield values in recent years. Although certain cultural practices can help mitigate these stress factors, they are often limited, costly, and time-consuming. Therefore, identifying and developing drought-resistant varieties is a more sustainable long-term solution.

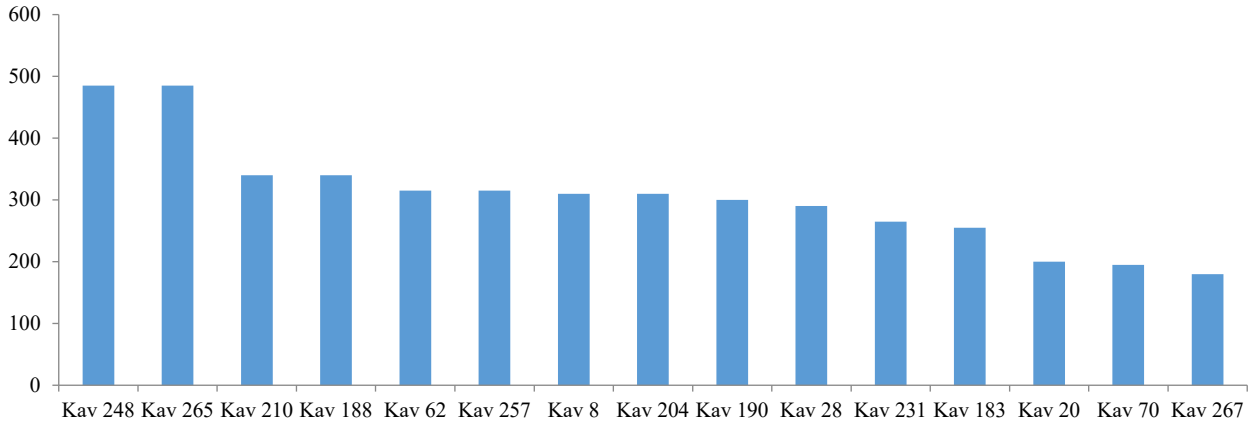


Figure 15. Weighted Rating Score Ranking of the Genotypes Used in the Special Screening Experiment, X: Genotypes. Y: Weighted Rating Score

In the pre-screening screening phase conducted in the first year of the research, 192 melon genotypes were grown under drought stress conditions for two months, and parameters such as stem length, stem dry weight, root dry weight, leaf number, and the 0-5 scale were examined in the green parts and roots of the plants. Based on the measurements and weighings of the 192 genotypes used in the pre-screening screening phase, the Modified Weighted Rating Method was employed to evaluate the data and select genotypes for drought tolerance. A total of 15 drought-tolerant and sensitive genotypes were selected for a second stress screening under hydroponic conditions in a climate-controlled plant growth chamber using an 8% PEG 6000 solution. Melon genotypes and control plants were grown under drought-stress conditions for 72 hours in this special screening phase. Several parameters were assessed, including the 0-5 visual scale, stem fresh and dry weight, root fresh and dry weight, stem and root length, leaf number, leaf relative water content, relative water content, and electrolyte leakage in both shoots and roots. Using the Modified Weighted Rating Method to evaluate the data from the special screening phase, the results of both the pre-screening and special screening experiments were combined. Among the 192 melon genotypes studied, the Kav 248 genotype was identified as highly drought-tolerant, while the Kav 20 genotype was drought-sensitive (Figure 15).

Declarations

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