

Changes in some seedling growth parameters, nutrient content and enzyme activity in different melon (*Cucumis melo* L.) genotypes under deficit irrigation conditions

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ABSTRACT

Increasing need for drought adaptation measures to conserve water and sustain crop yield in water-scarce regions, driven by severe and recurrent droughts. Achieving sustainable production entails studying deficit irrigation as a means to enhance water productivity and selecting genotypes resilient to soil water deficits. In the present study, 17 different melon (*Cucumis melo* L.) genotypes collected from the Van Lake Basin and 3 hybrids and 1 standard melon cultivar for control purposes were used. The study was carried out under climate room conditions. Two different irrigation levels (I₁₀₀: 100% full irrigation, I₅₀: 50% deficit irrigation-DI) were applied in the study for deficit irrigation. The applications started with the emergence of the second true leaves of the plants and after one-month, different growth, nutrient, and enzyme contents of the seedlings were determined. In general, it was determined that deficit water application negatively affects seedling growth, and root dry matter, stomatal width and density, potassium, APX and SOD enzymes, and MDA content increased, while the other examined parameters decreased. The genotypes of the Van Lake Basin melon were found to vary as a result of the findings.

Keywords: Antioxidative response, Deficit irrigation, Melon, Mineral composition, Seedling growth parameters.

INTRODUCTION

Melon (*Cucumis melo* L.), renowned for its rich nutritional profile, originates from East Africa (Pitrat 2008). Global melon production, totaling around 32 million tons, sees China (PRC) as the leading contributor, accounting for 40%, while Türkiye follows closely with approximately 5.5%

37 (FAO 2019). Türkiye, a recognized gene center for various crops, including melon, stands as a
38 secondary gene center for this species (Sensoy et al. 2007a; Erdinc et al. 2013; Kısaca and Gazioglu
39 Sensoy 2022). The Van province in Eastern Anatolia, Türkiye, holds significance as one of the
40 origins of cantaloupe melon (Sensoy et al. 2007a; Turkmen et al. 2008). Genetic studies by Sensoy
41 and Sahin (2012) revealed a notably high genetic diversity among Sihke melon genotypes in the
42 Lake Van Basin.

43 Drought, a prominent abiotic stressor, significantly jeopardizes global agricultural yield and
44 quality. With the escalation of global warming-induced climate change, arid and semi-arid regions
45 face exacerbated drought challenges (Tan et al. 2006; Pandey et al. 2018). Under drought
46 conditions, plant growth and development are impeded due to slowed cell division, interrupted
47 transpiration, and inhibited nutrient uptake, leading to diminished productivity (Sensoy et al.
48 2007b; Farooq et al. 2009; Cakmakci et al. 2017). In nations heavily reliant on agriculture,
49 optimizing water resource utilization is imperative to alleviate the adverse impacts of climate
50 change.

51 To address future challenges arising from climate change and a growing global population, it is
52 crucial to develop drought-tolerant plant genotypes requiring less water. In Türkiye, insufficient
53 precipitation has led to significant agricultural losses, emphasizing the urgent need to identify and
54 select drought-tolerant genotypes through expanded breeding programs (Kabay and Sensoy 2016).
55 Melon, a globally cultivated fruit with high nutritional and economic value, faces water scarcity
56 issues, particularly in arid regions. Deficit irrigation (DI), a water-saving strategy, seeks to enhance
57 water use efficiency while sustaining plant growth. Numerous studies have explored the impact of
58 DI on melon growth parameters across different genotypes (Sensoy et al. 2007b; Kusvuran et al.
59 2011; Sharma et al. 2014; Kırmak and Dogan 2017; Wang et al. 2017; Barzegar et al. 2018; Lamaoui
60 et al. 2018). Understanding the genetic variability and inheritance of physiological traits under DI
61 is vital. This study focuses on evaluating melon genotypes from the Van Lake Basin for their
62 response to water deficit during the seedling stage, utilizing morphological and physiological
63 parameters to identify tolerant genotypes for future breeding programs.

64 MATERIALS AND METHODS

65 Sihke melon genotypes sourced from the Van Lake Basin, alongside three hybrids and a standard
66 cultivar for control (Table 1), constituted the plant materials for this study. Under climate room
67 conditions (16 hours light, 8 hours dark, % 50-55 humidity and 23-25°C), seeds of the genotypes
68

69 were sown in 2-liter pots containing a sterile 2:1 peat to perlite ratio. The experiment featured two
 70 irrigation levels: I_{100} (100% full irrigation) and I_{50} (50% deficit irrigation). The study consists of a
 71 two-factor factorial design (melon genotype and irrigation) regime. Employing a randomized
 72 experimental design with three replications, each (total 126 pots) replication housed four plants.
 73 The initiation of applications coincided with the emergence of the second true leaves of the
 74 seedlings.

75 A and B solutions, comprising nutrients (A solutions: 10.03% N, 1.6% $\text{NH}_4\text{-N}$, 8.7% $\text{NO}_3\text{-N}$, 7.5%
 76 K_2O , 8.6% Ca, 0.3 % Fe and B solution; 2.1% N, 2.1% $\text{NO}_3\text{-N}$, 6.4% P_2O_5 , 11.6% K_2O , 1.6% Mg,
 77 0.01% Zn, 0.003% Cu, 0.1% Mn, 0.003% B, 0.004% Mo), were administered (50 ml) to all pots.
 78 Pre-planned irrigations followed, with water applied to reach field capacity before each irrigation
 79 cycle, determined by the pot capacity. The irrigation water volume for each session was computed
 80 using the provided equation.

$$81 \quad I = ((W_i - 1) - W_i) * IR$$

82 Where, I is the amount of irrigation water (ml), W_{i-1} and W_i mass (kg) of the pot at day $i-1$ and i ,
 83 respectively (kg). IR is the irrigation levels (I_{100} : % 100, full irrigation; I_{50} : % 50 deficit).

84 The plants were hand-watered with tap water and the trial was terminated 30 days after sowing
 85 (Kadayifci et al. 2005).

86
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Table 1. Melon genotypes employed in the study.

Genotype	Provided Location information	Latitude (N)	Latitude (E)	Genotype	Provided Location information	Latitude (N)	Latitude (E)
YYU-1	Van-Sihke-Kiratli	38° 31' 57.9504"	43° 27' 47.3688"	YYU-21	Van-Unseli	38° 59' 6"	43° 35' 16"
YYU-4	Van-Sihke-Kiratli	38° 31' 57.9504"	43° 27' 47.3688"	YYU-22	Van-Ercis	39° 1' 52"	43° 21' 35"
YYU-6	Van-Sihke-Kiratli	38° 31' 57.9504"	43° 27' 47.3688"	YYU-23	Van-Ercek-Irgatli	38° 36' 38.0628"	43° 36' 52.4766"
YYU-10	Van-Sihke	38° 32' 1"	43° 25' 20"	YYU-25	Van-Ercek-Irgatli	38° 36' 38.0628"	43° 36' 52.4766"
YYU-11	Van-Sihke-Kiratli	38° 31' 57.9504"	43° 27' 47.3688"	YYU-29	Van-Ercek-Irgatli	38° 36' 38.0628"	43° 36' 52.4766"
YYU-12	Van-Sihke-Kiratli	38° 31' 57.9504"	43° 27' 47.3688"	YYU-30	Van-Ercek-Irgatli	38° 36' 38.0628"	43° 36' 52.4766"
YYU-13	Van-Sihke-Kiratli	38° 31' 57.9504"	43° 27' 47.3688"	Galia	Standard		
YYU-14	Van-Sihke-Kiratli	38° 31' 57.9504"	43° 27' 47.3688"	Kirkagac F ₁	Yüksel Tohum		
YYU-15	Van-Sihke-Kiratli	38° 31' 57.9504"	43° 27' 47.3688"	Lokum F ₁	Yüksel Tohum		
YYU-18	Van-Cakirbey	39° 9' 15.2064"	43° 21' 35.6868"	Napolyon F ₁	Yüksel Tohum		
YYU-20	Van-Unseli	38° 59' 6"	43° 35' 16"				

88

89 **Seedling Growth Parameters**

90 Upon completing the experiment, various seedling growth parameters were assessed,
91 encompassing shoot and root lengths, shoot diameter, leaf count, shoot and root fresh weights
92 (SFW and RFW), shoot dry weight (SDW), root dry weight (RDW), shoot and root dry matter
93 (SDM and RDM) quantities, and the root-to-shoot ratio (dry weight %) denoted as R/S. **Fresh**
94 **weights of roots and stems were measured on a precision scale and recorded as SFW AND RFW,**
95 **and the same samples were kept in an oven at 65 °C for 48 hours and their dry weights were**
96 **recorded as SDW and RDW. Stem and root dry matter ratios were calculated as percentages and**
97 **recorded as SDM and RDM.** Additionally, the genotypes' responses to deficit irrigation were
98 evaluated on a 0-5 scale, with 0 signifying no effect (akin to control plants) and 5 indicating severe
99 wilting and drying in leaves (Cakmakci et al. 2017).

100

101 **Stomatal Traits**

102 Stomatal traits, including stomatal density (units per mm²), stomatal area (µm²), and stomatal
103 width and length (µm), were determined using the lower epidermis of the 4th leaf of the plants. The
104 epidermis was carefully peeled and mounted on a slide with two water droplets (Kurtar et al. 2016).
105 Stoma quantification was conducted using the LAS EZ 3.0 program, examining tissue samples on
106 the slide at 40x magnification under a light microscope (LEICA DM500). Three randomly selected
107 areas of 0.08 mm² were analyzed for accurate assessment.

108

109 **Mineral matter content**

110 Macro-micro nutrient content in plant leaves was determined through the dry combustion method
111 (Kacar and Inal 2010). Plant leaf samples underwent a 48-hour drying process at 65 °C, followed
112 by crushing with a porcelain mortar. Subsequently, 0.5 grams of the dry samples were ashed at 550
113 °C. The resulting ash was dissolved in 3 N HCl. Potassium (K), calcium (Ca), magnesium (Mg),
114 iron (Fe), zinc (Zn), copper (Cu), and manganese (Mn) levels were quantified using an atomic
115 absorption spectrophotometer, while phosphorus (P) content was determined using a
116 spectrophotometer.

117

118 **Enzyme Activation**

119 Superoxide dismutase (SOD) activity was assessed by inhibiting nitro blue tetrazolium (NBT) at
120 560 nm (Jebara et al., 2005). SOD activity was quantified as the unit reducing 50% of NBT.

121 Catalase (CAT) activity was determined by monitoring H₂O₂ disappearance at 240 nm, following
122 Cakmak and Marschner's method (1992). Ascorbate peroxidase (APX) activity was measured by
123 reducing H₂O₂ bound to ascorbic acid at 290 nm, with APX activity defined as the enzyme amount
124 needed to consume 1 μmol of ascorbate per minute (Cakmak and Marschner 1992).

125
126 **Lipid Peroxidation (MDA)**
127 Lipid peroxidation (MDA) was determined by the method of Heath and Packer (1968). The
128 absorbance value of the mixture was determined at 532 and 600 nm wavelengths and the MDA
129 content was calculated with a molar absorption coefficient of 155 mM cm⁻¹.

130
131 **Statistical evaluation**
132 Data from the study were statistically analyzed using the SPSS program, applying analysis of
133 variance with a significance level of p≤0.05. Significant mean differences were further categorized
134 using Duncan's Multiple Comparison Test. The XLSTAT statistical program, along with Principal
135 Component Analysis (PCA) as a multivariate data analysis method, was employed to discern and
136 emphasize similarities or differences resulting from the study's applications and examined features.
137 The extent to which these differences are explained was also determined.

138
139 **RESULTS**

140 **Seedling Growth**
141 Table 2 summarizes significant variations in leaf number, shoot diameter, and shoot/root lengths
142 among melon genotypes subjected to full and deficit irrigation. Overall, deficit irrigation resulted
143 in reduced leaf numbers across all genotypes, with YYU25 and YYU13 exhibiting the highest
144 (8.25) and lowest (4.38) values under full irrigation. Stem diameter showed considerable diversity,
145 ranging from 6.67 mm (YYU11) to 2.71 mm (YYU30). Full irrigation promoted longer shoot
146 lengths in YYU30 and cv. Napolyon (67.75 cm) and shorter lengths in YYU30 (27.69 cm). Root
147 lengths displayed variability, with certain genotypes displaying resilience to full irrigation.

148 Under deficit irrigation, the number of leaves declined, particularly in YYU25 (5.78) and YYU14
149 (2.97). Stem diameter ranged from 5.67 mm (YYU14) to 2.18 mm (YYU30). Shoot lengths were
150 longest in YYU29 (46.24 cm) and shortest in YYU14 (15.75 cm). Most genotypes experienced
151 reductions in shoot and root lengths, indicating diverse responses to deficit irrigation.

152
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Table 2. Seedling Growth Parameters in Melon Genotypes under I₁₀₀ and I₅₀ deficit Irrigation.

Genotype	Leaf number		Stem diameter (mm)		Shoot length (cm)		Root length (cm)	
	I ₁₀₀	I ₅₀	I ₁₀₀	I ₅₀	I ₁₀₀	I ₅₀	I ₁₀₀	I ₅₀
YYU1	5.50±0.43 ^{b-f}	4.36±0.13 ^{b-e}	5.00±1.92 ^{cf}	3.93±5.28 ^{d-g}	41.88±1.92 ^{b-d}	29.51±5.28 ^{b-e}	21.08±3.47	17.69±0.72
YYU4	5.50±0.43 ^{b-f}	3.50±0.25 ^{e-g}	5.39±6.57 ^{be}	4.50±4.35 ^{b-f}	44.58±6.57 ^{b-d}	28.54±4.35 ^{b-e}	18.38±1.85	14.47±1.53
YYU6	5.64±0.13 ^{b-f}	4.08±0.29 ^{c-f}	5.19±7.37 ^{cf}	4.40±2.64 ^{b-f}	38.69±7.37 ^{b-d}	25.21±2.64 ^{b-f}	20.75±2.54	15.75±3.45
YYU10	5.33±0.63 ^{c-f}	4.08±0.80 ^{c-f}	5.45±5.34 ^{bd}	4.31±7.06 ^{c-g}	33.51±5.34 ^{b-d}	25.23±7.06 ^{b-f}	16.67±2.80	14.88±1.44
YYU11	4.83±0.29 ^{d-f}	3.64±0.13 ^{d-g}	6.67±4.21 ^a	5.52±3.58 ^a	29.79±4.21 ^{cd}	21.08±3.58 ^{d-f}	23.11±3.78	17.65±0.67
YYU12	4.56±0.55 ^{ef}	3.00±0.00 ^{fg}	5.89±3.52 ^{ac}	4.69±1.35 ^{a-e}	30.83±4.07 ^{cd}	17.88±1.35 ^{ef}	19.00±0.99	18.04±1.28
YYU13	4.38±0.57 ^f	4.39±1.40 ^{b-e}	6.45±4.05 ^{ab}	5.19±2.77 ^{a-c}	30.25±2.88 ^{cd}	19.29±2.77 ^{ef}	20.04±4.33	18.28±5.00
YYU14	5.47±1.63 ^{b-f}	2.97±0.61 ^g	6.28±8.50 ^{ab}	5.67±0.75 ^a	27.69±6.46 ^d	15.7±0.75 ^f	20.94±4.16	20.97±3.26
YYU15	5.50±1.06 ^{b-f}	4.67±0.76 ^{a-e}	5.18±10.34 ^{cf}	5.39±3.50 ^{ab}	36.63±9.16 ^{b-d}	23.00±3.50 ^{c-f}	21.81±4.51	17.97±3.39
YYU18	8.17±2.04 ^a	4.25±0.25 ^{b-e}	4.95±10.13 ^f	4.45±3.86 ^{b-f}	36.00±0.75 ^{b-d}	24.96±3.63 ^{b-f}	18.96±3.71	17.92±1.23
YYU20	6.67±0.38 ^{a-e}	4.75±0.43 ^{a-d}	5.14±7.56 ^{cf}	4.12±7.63 ^{d-g}	52.17±10.13 ^{ac}	24.79±3.86 ^{b-f}	17.63±2.13	17.96±4.12
YYU21	7.31±2.08 ^a	4.28±0.05 ^{b-e}	5.12±17.38 ^f	4.91±3.06 ^{a-d}	47.08±7.56 ^{a-d}	34.75±7.63 ^{bc}	16.79±3.73	18.51±3.45
YYU22	7.64±1.76 ^{ab}	4.53±0.94 ^{b-e}	4.98±15.02 ^{cf}	4.52±8.26 ^{b-f}	55.75±17.38 ^{ab}	33.13±3.06 ^{b-d}	21.75±3.85	18.51±2.61
YYU23	7.67±0.29 ^{ab}	4.67±0.38 ^{a-e}	4.57±8.72 ^{dg}	3.74±7.12 ^{e-g}	48.04±15.02 ^{ad}	27.46±8.26 ^{b-f}	16.76±2.56	14.90±0.57
YYU25	8.25±1.34 ^a	5.78±0.46 ^a	4.17±20.82 ^{fg}	3.61±16.25 ^{fg}	52.79±8.72 ^{a-c}	36.79±7.12 ^{ab}	18.17±2.89	15.20±1.92
YYU29	5.75±1.30 ^{b-f}	4.25±0.75 ^{b-e}	4.40±21.41 ^{bg}	3.80±7.50 ^{e-g}	68.75±20.82 ^a	46.24±16.25 ^a	15.29±1.12	18.42±0.59
YYU30	5.33±1.28 ^{c-f}	4.75±0.90 ^{a-d}	2.71±10.26 ^h	2.18±4.88 ^h	39.17±21.41 ^{bd}	33.58±7.50 ^{bc}	17.94±3.77	16.45±0.51
Galia	6.47±0.21 ^{a-f}	5.29±0.25 ^{ab}	4.62±0.75 ^{dg}	4.77±3.63 ^{a-e}	31.58±10.26 ^{cd}	34.82±4.88 ^{bc}	18.58±3.00	20.38±2.26
Kirkagac	6.14±1.32 ^{a-f}	4.50±0.43 ^{b-e}	4.30±24.19 ^{eg}	3.83±5.03 ^{e-g}	44.64±24.19 ^{bd}	32.92±5.03 ^{b-d}	17.21±3.05	21.40±8.64
Lokum	6.22±1.28 ^{a-f}	5.00±0.66 ^{a-c}	3.63±14.44 ^{gh}	3.29±3.31 ^g	32.19±14.44 ^{cd}	33.25±3.31 ^{b-d}	13.79±6.29	15.54±1.91
Napolyon	7.00±1.56 ^{ad}	4.50±0.43 ^{b-e}	4.43±6.25 ^{dg}	3.95±8.82 ^{d-g}	68.75±6.25 ^a	29.78±8.82 ^{b-e}	17.50±0.76	16.25±0.78
*p-value	0.001	0.000	0.001	0.000	0.001	0.000	0.152	0.247

I₁₀₀: Full irrigation, I₅₀: 50% deficit irrigation *: Significant distinctions among groups were observed at the P< 0.05 level, as determined by Duncan's multiple comparison test.

Table 3 illustrates significant variations in parameters among genotypes and cultivars under full irrigation, excluding RDW. YYU14 displayed the highest SFW in full irrigation (22.06 g), while YYU30 had the lowest (4.34 g). Under deficit irrigation, YYU15 recorded the highest SFW (13.05 g), and YYU30 had the lowest (3.50 g). SDW responded positively to stress in YYU29 and YYU30, while other genotypes showed negative effects. In full irrigation, YYU18 exhibited the highest SDW (1.35 g), and YYU30 showed the lowest (0.39 g). Under deficit irrigation, YYU13 and YYU15 displayed the highest SDW (0.88 g and 0.86 g, respectively), while YYU30 had the lowest (0.40 g). For RFW, all genotypes experienced a decrease under stress, while RDW increased in four genotypes and three cultivars. YYU15 demonstrated the highest RFW in full irrigation (1.59 g), and YYU30 had the lowest (0.49 g). Under deficit irrigation, YYU14 recorded the highest RFW (0.98 g), with YYU30 displaying the lowest (0.31 g). In deficit irrigation, the highest RDW was in YYU12 (0.083 g), while the lowest was in YYU25 (0.024 g).

177 **Table 3. Seedling Growth Traits Variation in Melon Genotypes under $-I_{100}$ and I_{50} Deficit Irrigation: Selected Values**
 178 **and Standard Deviations.**

Genotype	Shoot fresh weight (g)		Shoot dry weight (g)		Root fresh weight (g)		Root dry weight (g)	
	I_{100}	I_{50}	I_{100}	I_{50}	I_{100}	I_{50}	I_{100}	I_{50}
YYU1	15.99 \pm 1.05 ^{b-d}	9.87 \pm 2.83 ^{b-d}	0.80 \pm 0.11 ^{b-e}	0.55 \pm 0.18 ^{b-d}	0.89 \pm 0.13 ^{b-e}	0.62 \pm 0.21 ^{a-e}	0.044 \pm 0.004	0.053 \pm 0.015 ^{a-f}
YYU4	14.73 \pm 0.23 ^{b-e}	8.41 \pm 0.47 ^{b-f}	0.99 \pm 0.13 ^{a-c}	0.63 \pm 0.08 ^{a-d}	0.89 \pm 0.11 ^{b-e}	0.53 \pm 0.14 ^{b-e}	0.056 \pm 0.005	0.043 \pm 0.009 ^{b-f}
YYU6	12.23 \pm 1.59 ^{c-f}	6.82 \pm 1.30 ^{d-f}	0.72 \pm 0.13 ^{c-e}	0.53 \pm 0.12 ^{b-d}	1.04 \pm 0.55 ^{a-e}	0.48 \pm 0.15 ^{c-e}	0.056 \pm 0.028	0.037 \pm 0.008 ^{c-f}
YYU10	15.36 \pm 1.40 ^{b-e}	7.32 \pm 2.00 ^{a-f}	0.97 \pm 0.10 ^{a-c}	0.54 \pm 0.18 ^{b-d}	0.81 \pm 0.18 ^{b-e}	0.52 \pm 0.15 ^{b-e}	0.051 \pm 0.012	0.041 \pm 0.008 ^{b-f}
YYU11	15.99 \pm 1.68 ^{b-d}	10.83 \pm 0.37 ^{ab}	1.12 \pm 0.12 ^{a-c}	0.74 \pm 0.09 ^{ab}	1.14 \pm 0.17 ^{a-e}	0.78 \pm 0.16 ^{a-d}	0.079 \pm 0.016	0.073 \pm 0.005 ^{a-c}
YYU12	16.81 \pm 1.34 ^{bc}	9.29 \pm 1.11 ^{b-e}	1.10 \pm 0.15 ^{a-c}	0.70 \pm 0.01 ^{a-c}	1.28 \pm 0.14 ^{a-d}	0.96 \pm 0.18 ^{ab}	0.080 \pm 0.016	0.083 \pm 0.02 ^a
YYU13	16.79 \pm 0.55 ^{bc}	13.01 \pm 2.32 ^a	0.98 \pm 0.12 ^{a-c}	0.88 \pm 0.10 ^a	1.23 \pm 0.28 ^{a-d}	0.88 \pm 0.20 ^{a-c}	0.079 \pm 0.041	0.072 \pm 0.025 ^{a-d}
YYU14	22.06 \pm 6.53 ^a	10.28 \pm 2.34 ^{a-c}	1.35 \pm 0.57 ^a	0.72 \pm 0.14 ^{a-c}	1.42 \pm 0.69 ^{ab}	0.98 \pm 0.37 ^a	0.087 \pm 0.028	0.072 \pm 0.039 ^{a-c}
YYU15	15.01 \pm 5.06 ^{b-e}	13.05 \pm 4.16 ^a	0.88 \pm 0.27 ^{b-d}	0.86 \pm 0.25 ^a	1.59 \pm 0.33 ^a	0.94 \pm 0.38 ^{ab}	0.062 \pm 0.040	0.074 \pm 0.028 ^{ab}
YYU18	18.92 \pm 4.53 ^{ab}	8.11 ^{b-f} \pm 0.21	1.35 \pm 0.26 ^a	0.70 \pm 0.03 ^{a-c}	1.34 \pm 0.77 ^{a-c}	0.76 \pm 0.16 ^{a-d}	0.082 \pm 0.019	0.061 \pm 0.008 ^{a-e}
YYU20	15.09 \pm 2.62 ^{b-e}	9.67 \pm 1.86 ^{b-d}	1.10 \pm 0.13 ^{a-c}	0.67 \pm 0.05 ^{a-c}	1.17 \pm 0.32 ^{a-d}	0.68 \pm 0.36 ^{a-e}	0.064 \pm 0.022	0.045 \pm 0.005 ^{b-f}
YYU21	15.74 \pm 1.86 ^{b-e}	7.74 \pm 0.28 ^{b-f}	1.19 \pm 0.14 ^{ab}	0.75 \pm 0.02 ^{ab}	1.01 \pm 0.18 ^{a-e}	0.60 \pm 0.08 ^{a-e}	0.085 \pm 0.013	0.073 \pm 0.031 ^{ab}
YYU22	12.53 \pm 1.93 ^{c-f}	7.68 \pm 1.67 ^{b-f}	0.89 \pm 0.23 ^{b-d}	0.67 \pm 0.22 ^{a-c}	0.83 \pm 0.07 ^{b-e}	0.73 \pm 0.37 ^{a-e}	0.055 \pm 0.027	0.065 \pm 0.032 ^{a-e}
YYU23	11.11 \pm 2.14 ^{d-g}	6.12 \pm 0.33 ^{e-g}	0.88 \pm 0.16 ^{b-d}	0.55 \pm 0.09 ^{b-d}	0.81 \pm 0.13 ^{b-e}	0.44 \pm 0.18 ^{c-e}	0.046 \pm 0.008	0.036 \pm 0.008 ^{d-f}
YYU25	13.19 \pm 3.98 ^{c-f}	6.60 \pm 1.67 ^{d-g}	0.88 \pm 0.23 ^{b-d}	0.54 \pm 0.12 ^{b-d}	0.68 \pm 0.33 ^{c-e}	0.37 \pm 0.10 ^{de}	0.040 \pm 0.022	0.024 \pm 0.004 ^f
YYU29	9.07 \pm 2.96 ^{fh}	6.57 \pm 0.74 ^{d-g}	0.53 \pm 0.23 ^{de}	0.54 \pm 0.05 ^{b-d}	0.65 \pm 0.32 ^{de}	0.40 \pm 0.15 ^{de}	0.054 \pm 0.035	0.037 \pm 0.008 ^{c-f}
YYU30	4.34 \pm 2.32 ^h	3.50 \pm 0.81 ^g	0.39 \pm 0.23 ^e	0.40 \pm 0.14 ^d	0.49 \pm 0.34 ^e	0.31 \pm 0.08 ^e	0.048 \pm 0.023	0.032 \pm 0.002 ^{ef}
Galia	11.29 \pm 1.89 ^{d-g}	7.53 \pm 1.43 ^{b-f}	0.75 \pm 0.14 ^{c-e}	0.66 \pm 0.04 ^{a-c}	0.76 \pm 0.25 ^{b-e}	0.69 \pm 0.18 ^{a-e}	0.053 \pm 0.022	0.054 \pm 0.008 ^{a-f}
Kirkagac	10.43 \pm 0.84 ^{e-g}	5.48 \pm 0.82 ^{fg}	0.99 \pm 0.22 ^{a-c}	0.55 \pm 0.07 ^{b-d}	0.87 \pm 0.38 ^{b-e}	0.55 \pm 0.21 ^{a-e}	0.068 \pm 0.049	0.048 \pm 0.013 ^{a-f}
Lokum	6.77 \pm 1.65 ^{gh}	6.25 \pm 0.95 ^{e-g}	0.55 \pm 0.28 ^{de}	0.47 \pm 0.12 ^{cd}	0.60 \pm 0.23 ^{de}	0.48 \pm 0.23 ^{c-e}	0.038 \pm 0.040	0.034 \pm 0.014 ^{ef}
Napolyon	13.14 \pm 3.42 ^{c-f}	8.28 \pm 2.20 ^{b-f}	0.87 \pm 0.16 ^{b-d}	0.67 \pm 0.23 ^{a-c}	0.65 \pm 0.23 ^{de}	0.60 \pm 0.28 ^{a-e}	0.045 \pm 0.037	0.046 \pm 0.022 ^{b-f}
*p-value	0.001	0.001	0.001	0.013	0.019	0.008	0.357	0.012

179 I_{100} : Full irrigation, I_{50} : 50% deficit irrigation, *: Significant distinctions among groups were observed at the $P < 0.05$
 180 level, as determined by Duncan's multiple comparison test.

181
 182 Significant variations in SDM content and 0-5 scale values were observed across genotypes and
 183 cultivars, with no notable differences in RDM contents and R/S (Table 4). SDM content generally
 184 increased with deficit irrigation, with exceptions in YYU11, YYU20, and Lokum. In full irrigation,
 185 cv. Kirkagac (9.58%) and genotype YYU30 (8.89%) had the highest SDM, while the lowest was
 186 in genotype YYU1 (4.97%). Similarly, in deficit irrigation, YYU30 (11.29%) and cv. Kirkagac
 187 (10.12%) showed the highest SDM, and genotype YYU1 (5.57%) had the lowest.

188 R/S ratio increased with deficit irrigation, except for YYU6, YYU25, YYU29, and YYU30. In
 189 full irrigation, genotypes YYU30 (0.142) and cv. Lokum (0.049) had the highest and lowest R/S
 190 ratios, respectively. Under deficit irrigation, YYU12 (0.119) and YYU25 (0.050) showed the
 191 highest and lowest R/S ratios, respectively. Genotypes YYU10 and YYU12 shared the highest 0-
 192 5 scale values (3.333), while cv. Lokum had the lowest (1.667).

197 **Table 4.** Dry Matter, Root/Shoot Ratio, and Vigor Assessment in Melon Genotypes under Full and 50% Deficit
 198 **Irrigation: Mean Values and Standard Deviations.**

Genotype	Shoot dry matter content (%)		Root dry matter content (%)		Root: Shoot ratio		0-5 scale
	I ₁₀₀	I ₅₀	I ₁₀₀	I ₅₀	I ₁₀₀	I ₅₀	I ₅₀
YYU1	4.97±0.40 ^d	5.57±0.38 ^g	5.11±1.20	8.88±2.89	0.056±0.003	0.102±0.047	2.333 ±1.15 ^{a-c}
YYU4	6.75 ±0.97 ^{b-d}	7.53±0.78 ^{d-f}	6.42±1.33	8.25±1.16	0.057±0.002	0.067±0.007	2.667 ±0.58 ^{a-c}
YYU6	5.87±0.65 ^{cd}	7.69±0.61 ^{d-f}	5.55±1.48	8.00±2.24	0.077±0.034	0.072±0.021	3.000±0.00 ^{ab}
YYU10	6.33 ±0.12 ^{b-d}	7.36±0.46 ^{d-f}	6.27±0.60	8.02±0.93	0.052±0.007	0.078±0.016	3.333±0.58 ^a
YYU11	7.00 ±0.70 ^{a-d}	6.80±0.75 ^{fg}	6.93±0.92	9.68±2.73	0.071±0.013	0.099±0.008	2.333 ±0.58 ^{a-c}
YYU12	6.54 ±0.48 ^{b-d}	7.58±0.98 ^{d-f}	6.22±0.76	8.75±2.31	0.069±0.016	0.119±0.033	3.333±0.58 ^a
YYU13	5.83±0.88 ^{cd}	6.79±0.46 ^{fg}	6.09±1.86	8.08±1.23	0.068±0.022	0.083±0.031	2.667 ±0.58 ^{a-c}
YYU14	5.99±0.93 ^{cd}	7.03 ±0.31 ^{e-g}	6.48±2.03	7.10±1.07	0.090±0.026	0.097±0.033	2.333 ±0.58 ^{a-c}
YYU15	5.90±0.20 ^{cd}	6.66±0.71 ^{fg}	3.69±1.77	7.97±0.96	0.070±0.053	0.084±0.010	2.000±0.00 ^{bc}
YYU18	7.19 ±0.93 ^{a-d}	8.63 ±0.19 ^{b-e}	7.06±2.92	8.26±2.00	0.061±0.003	0.087±0.012	1.667±0.58 ^c
YYU20	7.37 ±1.12 ^{a-d}	7.06 ±1.38 ^{e-g}	5.89±2.79	9.55±0.45	0.058±0.013	0.066±0.004	2.667 ±0.58 ^{a-c}
YYU21	7.58 ±1.06 ^{a-d}	9.74 ±0.40 ^{a-c}	8.62±2.06	11.81±3.57	0.073±0.021	0.096±0.039	2.667 ±0.58 ^{a-c}
YYU22	7.01 ±0.83 ^{a-d}	8.64 ±0.88 ^{b-e}	6.60±2.99	8.98±2.15	0.060±0.014	0.094±0.029	3.000±0.00 ^{ab}
YYU23	7.98 ±0.72 ^{a-c}	8.96 ±1.02 ^{b-d}	5.74±0.75	8.90±2.11	0.052±0.003	0.067±0.021	2.667 ±0.58 ^{a-c}
YYU25	6.73 ±0.33 ^{b-d}	8.31 ±0.85 ^{c-f}	5.61±0.68	7.26±0.74	0.050±0.037	0.050±0.010	3.000±1.00 ^{ab}
YYU29	6.13 ±3.19 ^{b-d}	8.25 ±0.57 ^{c-f}	7.80±3.08	9.67±2.83	0.122±0.090	0.069±0.014	2.000±0.00 ^{bc}
YYU30	8.89±0.87 ^{ab}	11.29±1.64 ^a	12.72±7.56	9.44±1.94	0.142±0.066	0.092±0.040	3.000±1.00 ^{ab}
Galia	6.81 ±1.88 ^{b-d}	9.02 ±2.11 ^{b-d}	7.72±4.60	8.07±1.19	0.071±0.031	0.082±0.072	2.333 ±0.58 ^{a-c}
Kirkagac	9.58±2.42 ^a	10.12 ±0.25 ^{a-b}	7.23±3.33	9.02±1.67	0.067±0.022	0.085±0.011	3.000±0.00 ^{ab}
Lokum	7.83 ±2.61 ^{a-c}	7.50±1.08 ^{df}	5.27±3.86	7.46±2.05	0.049±0.006	0.068±0.005	1.667±0.58 ^c
Napolyon	6.88 ±2.15 ^{b-d}	7.91±0.92 ^{df}	6.28±2.97	7.75±0.35	0.057±0.012	0.069±0.006	2.667 ±0.58 ^{a-c}
*p-value	0.061	0.000	0.398	0.581	0.227	0.253	0.052

199 I₁₀₀: Full irrigation, I₅₀: 50% deficit irrigation, *: Significant distinctions among groups were observed at the P< 0.05
 200 level, as determined by Duncan's multiple comparison test.

202 Stomatal Traits

203 Stomatal characteristics in melon genotypes and cultivars significantly differed under full and
 204 deficit irrigation (Table 5). Stomatal length and area decreased in 52.38% of cases, while width
 205 and density increased by 71.43% and 61.91%, respectively. In full irrigation, genotype YYU22 had
 206 the tallest stoma (23.73 μm), and genotype YYU6 had the shortest (8.47 μm). Under deficit
 207 irrigation, genotypes YYU25 and YYU22 showed the tallest stomata (21.80 μm and 21.47 μm),
 208 and genotype YYU6 had the shortest (14.47 μm). For stoma width, genotype YYU13 had the
 209 widest (15.58 μm) in full irrigation, and genotype YYU6 had the narrowest (7.97 μm). In deficit
 210 irrigation, genotype YYU21 had the widest (17.20 μm), and genotype YYU6 had the narrowest
 211 (10.78 μm). Regarding stoma area, genotype YYU22 had the widest (252.94 μm²) in full irrigation,
 212 and genotype YYU6 had the narrowest (53.03 μm²). In deficit irrigation, genotype YYU21 had the
 213 widest (288.05 μm²), and genotype YYU6 had the narrowest (124.28 μm²). In full irrigation, cv.
 214 Kirkagac displayed the highest stoma intensity (362.50 units per mm²), and genotype YYU15 had
 215 the lowest (56.25 units per mm²). Under deficit irrigation, genotype YYU6 showed the highest
 216 stoma intensity (516.67 units per mm²), with genotype YYU15 displaying the lowest (108.33 units
 217 per mm²).

218 **Table 5.** Stomatal Traits of Melon Genotypes under Full and 50% Deficit Irrigation; Mean Values and Standard
 219 Deviations.

Genotype	Stoma height (μm)		Stoma width (μm)		Stoma area (μm^2)		Stoma intensity (unit per mm^2)	
	I ₁₀₀	I ₅₀	I ₁₀₀	I ₅₀	I ₁₀₀	I ₅₀	I ₁₀₀	I ₅₀
YYU1	19.04 ±1.98 ^{b-f}	17.93 ±1.66 ^{a-f}	12.76 ±1.37 ^{c-h}	13.82 ±1.37 ^{a-f}	189.56 ±12.55 ^{b-g}	194.09 ±20.41 ^{b-g}	108.33 ±19.09 ^{b-i}	137.50 ±21.65 ^{g-h}
YYU4	12.61 ±1.63 ^h	15.90 ±0.80 ^{d-f}	9.49 ±0.78 ⁱⁱ	13.16 ±2.13 ^{b-f}	94.42 ±18.34 ^{hi}	164.91 ±33.80 ^{d-f}	250.00 ±12.50 ^{b-d}	350.00 ±33.07 ^b
YYU6	8.47 ±0.71 ^l	14.47 ±0.2 ^f	7.97 ±0.15 ^l	10.95 ±0.98 ^{ef}	53.03 ±4.76 ^l	124.28 ±9.46 ^f	162.50 ±12.50 ^{c-h}	516.67 ±7.22 ^a
YYU10	17.32 ±0.64 ^{c-g}	16.97 ±2.32 ^{b-f}	13.43 ±0.80 ^{a-g}	13.50 ±2.10 ^{b-f}	182.38 ±4.70 ^{c-g}	179.11 ±33.72 ^{b-f}	129.17 ±28.87 ^{g-i}	320.83 ±14.43 ^{bc}
YYU11	19.02 ±0.98 ^{b-f}	17.10 ±4.10 ^{b-f}	14.33 ±1.61 ^{a-d}	14.25 ±3.97 ^{a-f}	214.76 ±34.44 ^{a-e}	198.75 ±102.02 ^{b-f}	216.67 ±14.43 ^{c-e}	316.67 ±19.09 ^{bc}
YYU12	18.82 ±1.50 ^{b-f}	19.33 ±0.91 ^{a-e}	14.00 ±1.8 ^{a-e}	16.69 ±2.24 ^{ab}	206.30 ±28.21 ^{a-f}	253.59 ±38.79 ^{a-c}	278.13 ±57.17 ^{bc}	270.83 ±52.04 ^{cd}
YYU13	16.65 ±1.54 ^{c-g}	20.37 ±1.01 ^{a-c}	15.58 ±0.70 ^a	13.94 ±0.85 ^{a-f}	204.03 ±25.93 ^{a-f}	222.66 ±11.80 ^{a-e}	312.50 ±54.49 ^{ab}	133.33 ±7.22 ^{g-h}
YYU14	17.08 ±2.48 ^{b-g}	15.40 ±2.46 ^{def}	11.64 ±0.73 ^{e-i}	10.78 ±0.85 ^f	156.35 ±26.69 ^{fg}	130.05 ±19.67 ^f	220.83 ±127.68 ^{ce}	212.50 ±12.50 ^{ef}
YYU15	18.00 ±1.60 ^{b-g}	18.60 ±0.56 ^{a-f}	12.12 ±0.04 ^{d-h}	13.02 ±1.97 ^{b-f}	171.23 ±14.60 ^{e-g}	189.50 ±22.77 ^{b-f}	56.25 ±8.84 ⁱ	108.33 ±14.43 ^h
YYU18	18.09 ±2.75 ^{b-g}	16.07 ±0.40 ^{d-f}	10.96 ±1.35 ^{g-i}	11.54 ±0.88 ^{d-f}	155.50 ±29.53 ^{fg}	145.77 ±14.85 ^{ef}	116.67 ±7.22 ^{h-i}	237.50 ±45.07 ^{de}
YYU20	20.52 ±1.12 ^{bc}	17.17 ±2.16 ^{b-f}	14.56 ±1.79 ^{a-d}	14.69 ±1.23 ^{a-d}	235.00 ±37.37 ^{a-d}	198.37 ±33.77 ^{b-f}	87.50 ±12.50 ⁱⁱ	200.00 ±45.07 ^{ef}
YYU21	16.80 ±1.27 ^{d-g}	20.97 ±2.65 ^{ab}	12.98 ±1.40 ^{b-h}	17.20 ±4.23 ^a	170.25 ±6.95 ^{e-g}	288.05 ±102.96 ^a	179.17 ±7.22 ^{e-h}	133.33 ±7.22 ^{g-h}
YYU22	23.73 ±2.34 ^a	21.47 ±2.17 ^a	13.56 ±0.61 ^{a-f}	14.66 ±1.00 ^{a-e}	252.94 ±31.48 ^a	248.11 ±42.36 ^{a-d}	75.00 ±21.65 ^{l-i}	166.67 ±7.22 ^{fg}
YYU23	15.27 ±2.20 ^{gh}	19.97 ±3.09 ^{a-d}	11.51 ±0.88 ^{e-i}	12.77 ±1.98 ^{c-f}	137.74 ±20.67 ^{fg}	203.29 ±64.20 ^{b-f}	129.17 ±7.22 ^{g-i}	204.17 ±28.87 ^{ef}
YYU25	16.50 ±1.84 ^{fg}	21.80 ±2.84 ^a	10.74 ±1.02 ^{hi}	15.47 ±1.27 ^{a-c}	138.16 ±6.71 ^{fg}	264.78 ±42.66 ^{ab}	137.50 ±21.65 ^{g-i}	170.83 ±14.43 ^{fg}
YYU29	20.06 ±1.79 ^{b-e}	15.90 ±1.22 ^{d-f}	15.40 ±1.18 ^{ab}	15.22 ±0.97 ^{a-d}	243.55 ±39.48 ^{ab}	189.34 ±4.10 ^{b-f}	141.67 ±19.09 ^{f-i}	170.83 ±7.22 ^{fg}
YYU30	19.71 ±2.72 ^{b-f}	20.50 ±2.52 ^{a-c}	15.21 ±2.34 ^{a-c}	12.95 ±1.19 ^{c-f}	238.61 ±70.97 ^{a-c}	208.50 ±31.91 ^{a-f}	195.83 ±7.22 ^{d-g}	166.67 ±47.32 ^{fg}
Galia	21.29 ±1.35 ^{ab}	19.50 ±2.65 ^{a-e}	13.02 ±1.76 ^{b-h}	13.39 ±1.22 ^{b-f}	218.30 ±39.26 ^{a-e}	206.52 ±46.52 ^{a-f}	87.50 ±33.07 ⁱⁱ	133.33 ±14.43 ^{g-h}
Kirkagac	18.56 ±1.94 ^{b-g}	16.63 ±0.75 ^{c-f}	12.42 ±0.82 ^{d-h}	13.72 ±1.65 ^{a-f}	180.46 ±13.41 ^{d-g}	179.66 ±29.11 ^{b-f}	362.50 ±12.50 ^a	279.17 ±40.18 ^{cd}
Lokum	20.27 ±1.11 ^{b-d}	19.60 ±3.55 ^{a-e}	14.47 ±1.42 ^{a-d}	11.59 ±1.65 ^{d-f}	230.48 ±28.60 ^{a-d}	175.43 ±9.58 ^{c-f}	208.33 ±7.22 ^{c-e}	200.00 ±54.49 ^{ef}
Napolyon	16.41 ±1.91 ^{fg}	19.67 ±0.35 ^{a-d}	11.31 ±0.95 ^{f-i}	12.67 ±0.29 ^{c-f}	146.46 ±27.17 ^{gh}	195.61 ±1.91 ^{b-f}	216.67 ±19.09 ^{c-e}	137.50 ±12.50 ^{g-h}
*p-value	0.001	0.001	0.001	0.007	0.001	0.003	0.001	0.001

220 I₁₀₀: Full irrigation, I₅₀: 50% deficit irrigation, *: Significant distinctions among groups were observed at the P < 0.05
 221 level, as determined by Duncan's multiple comparison test.

222 Mineral Content

224 Differences in mean K, Ca, and Mg contents among melon genotypes and cultivars were
 225 significant under both full and deficit irrigation conditions, with P content showing significance
 226 exclusively in deficit irrigation (Table 6). Deficit irrigation led to a decrease in P and Mg uptake
 227 in 66% of genotypes and cultivars, while 90% experienced reduced Ca intake. In full irrigation, the
 228 highest K content occurred in genotypes YYU6 (6.28%) and YYU21 (6.25%), while the lowest
 229 was in genotype YYU20 (2.91%). Under deficit irrigation, the highest K content was in genotype
 230 YYU29 (6.58%), and the lowest was in genotype YYU12 (4.56%) and cv. Lokum (4.44%). For P
 231 content in deficit irrigation, the highest was in genotype YYU29 (0.92%), and the lowest was in
 232 genotype YYU10 (0.46%). In both full and deficit irrigation, the highest Ca content was in
 233 genotypes YYU30 (7.72% and 5.65%, respectively), and the lowest was in genotype YYU12
 234 (3.83% and 4.22%, respectively). In full irrigation, the highest Mg content was in genotype YYU30
 235 (7.72%), and the lowest was in genotype YYU20 (0.49%). Under deficit irrigation, the highest Mg
 236 content was in genotype YYU30 (0.73%), and the lowest was in cv. Lokum (0.48%).

Table 6. Macro mineral contents in melon genotypes under full and 50% deficit irrigation.

Genotype	K (%)		P (%)		Ca (%)		Mg (%)	
	I ₁₀₀	I ₅₀	I ₁₀₀	I ₅₀	I ₁₀₀	I ₅₀	I ₁₀₀	I ₅₀
YYU1	6.00 ± 0.57 ^{ac}	5.78 ± 0.51 ^{ac}	1.06 ± 0.02	0.76 ± 0.07 ^{ab}	5.73 ± 0.52 ^{b-e}	4.34 ± 0.60 ^{cd}	0.64 ± 0.05 ^{d-g}	0.57 ± 0.06 ^{b-e}
YYU4	4.87 ± 0.14 ^{af}	5.55 ± 0.61 ^{ad}	0.71 ± 0.28	0.85 ± 0.10 ^{ab}	4.39 ± 1.48 ^{ef}	4.28 ± 0.52 ^{cd}	0.71 ± 0.09 ^{c-g}	0.52 ± 0.10 ^{de}
YYU6	6.28 ± 0.61 ^a	6.09 ± 0.91 ^{ab}	0.86 ± 0.33	0.79 ± 0.15 ^{ab}	5.93 ± 1.06 ^{b-e}	4.31 ± 0.75 ^{cd}	0.69 ± 0.20 ^{d-g}	0.51 ± 0.06 ^{de}
YYU10	5.81 ± 0.42 ^{a-d}	5.92 ± 0.58 ^{ac}	0.80 ± 0.09	0.46 ± 0.07 ^c	5.75 ± 0.65 ^{b-e}	4.32 ± 0.43 ^{cd}	0.68 ± 0.10 ^{d-g}	0.52 ± 0.03 ^{de}
YYU11	4.36 ± 0.43 ^{cg}	4.97 ± 0.25 ^{bd}	0.73 ± 0.19	0.62 ± 0.12 ^{bc}	5.26 ± 0.33 ^{c-f}	4.29 ± 0.39 ^{cd}	0.75 ± 0.10 ^{c-f}	0.56 ± 0.02 ^{be}
YYU12	4.52 ± 0.59 ^{bf}	4.56 ± 0.64 ^d	0.87 ± 0.12	0.59 ± 0.10 ^{bc}	6.19 ± 0.64 ^{a-e}	4.22 ± 0.21 ^d	0.92 ± 0.15 ^{bc}	0.60 ± 0.04 ^{a-e}
YYU13	5.48 ± 0.27 ^{ae}	5.52 ± 0.64 ^{ad}	0.92 ± 0.01	0.82 ± 0.17 ^{ab}	7.22 ± 0.42 ^{ab}	5.04 ± 0.45 ^{a-d}	1.01 ± 0.13 ^b	0.66 ± 0.03 ^{a-c}
YYU14	4.76 ± 0.22 ^{af}	5.12 ± 0.72 ^{bd}	0.78 ± 0.14	0.69 ± 0.20 ^{ac}	5.83 ± 0.73 ^{b-e}	5.30 ± 0.31 ^{a-d}	0.71 ± 0.17 ^{c-g}	0.69 ± 0.06 ^{ab}
YYU15	3.42 ± 0.68 ^{fg}	5.58 ± 0.09 ^{ad}	0.87 ± 0.14	0.74 ± 0.03 ^{ab}	5.57 ± 2.99 ^{b-f}	4.59 ± 0.38 ^{a-d}	0.65 ± 0.31 ^{d-g}	0.57 ± 0.02 ^{b-e}
YYU18	3.95 ± 0.44 ^{eg}	5.48 ± 0.79 ^{ad}	0.69 ± 0.00	0.63 ± 0.16 ^{bc}	4.61 ± 0.18 ^{ef}	5.11 ± 0.79 ^{a-d}	0.58 ± 0.09 ^{e-g}	0.66 ± 0.10 ^{a-c}
YYU20	2.91 ± 0.53 ^g	5.19 ± 1.17 ^{bd}	0.78 ± 0.03	0.73 ± 0.14 ^{ab}	3.83 ± 0.53 ^f	4.43 ± 0.47 ^{cd}	0.49 ± 0.09 ^g	0.57 ± 0.06 ^{b-e}
YYU21	6.25 ± 1.69 ^a	5.34 ± 0.71 ^{bd}	0.79 ± 0.10	0.75 ± 0.11 ^{ab}	6.45 ± 0.51 ^{a-d}	4.87 ± 0.30 ^{a-d}	0.85 ± 0.18 ^{b-d}	0.69 ± 0.05 ^{a-b}
YYU22	5.29 ± 1.19 ^{ae}	5.33 ± 0.46 ^{bd}	0.98 ± 0.11	0.76 ± 0.06 ^{ab}	5.55 ± 0.98 ^{b-f}	5.10 ± 0.60 ^{a-d}	0.65 ± 0.10 ^{d-g}	0.64 ± 0.14 ^{a-d}
YYU23	5.32 ± 0.29 ^{ae}	5.33 ± 0.16 ^{bd}	0.93 ± 0.00	0.69 ± 0.35 ^{ac}	6.83 ± 0.17 ^{a-c}	4.53 ± 1.17 ^{b-d}	0.78 ± 0.06 ^{c-e}	0.58 ± 0.04 ^{b-e}
YYU25	4.52 ± 0.04 ^{bf}	4.71 ± 0.80 ^{cd}	0.71 ± 0.36	0.85 ± 0.07 ^{ab}	6.06 ± 0.54 ^{a-e}	4.97 ± 0.62 ^{a-d}	0.70 ± 0.08 ^{c-g}	0.61 ± 0.09 ^{a-d}
YYU29	4.64 ± 1.47 ^{af}	6.58 ± 0.69 ^a	0.85 ± 0.21	0.92 ± 0.12 ^a	5.14 ± 1.32 ^{c-f}	5.53 ± 0.36 ^{ab}	0.60 ± 0.11 ^{e-g}	0.67 ± 0.02 ^{ab}
YYU30	6.16 ± 1.45 ^{ab}	5.01 ± 0.19 ^{bd}	0.85 ± 0.17	0.65 ± 0.04 ^{bc}	7.72 ± 1.25 ^a	5.65 ± 0.34 ^a	1.41 ± 0.01 ^a	0.73 ± 0.05 ^a
Galia	5.14 ± 0.37 ^{ae}	4.87 ± 0.18 ^{cd}	0.93 ± 0.12	0.74 ± 0.08 ^{ab}	6.12 ± 0.61 ^{a-e}	5.37 ± 0.56 ^{a-c}	0.67 ± 0.09 ^{d-g}	0.64 ± 0.07 ^{a-d}
Kirkagac	4.32 ± 1.55 ^{dg}	5.23 ± 0.58 ^{bd}	0.78 ± 0.26	0.69 ± 0.07 ^{ac}	5.13 ± 0.74 ^{c-f}	4.69 ± 0.37 ^{a-d}	0.55 ± 0.02 ^{e-g}	0.53 ± 0.04 ^{c-e}
Lokum	5.09 ± 1.03 ^{ae}	4.44 ± 0.53 ^d	0.85 ± 0.33	0.80 ± 0.10 ^{ab}	5.00 ± 0.36 ^{d-f}	4.78 ± 0.25 ^{a-d}	0.52 ± 0.08 ^{f-g}	0.48 ± 0.03 ^e
Napolyon	5.73 ± 0.03 ^{ad}	4.97 ± 0.27 ^{b-d}	0.83 ± 0.01	0.77 ± 0.01 ^{ab}	5.34 ± 1.25 ^{c-f}	5.08 ± 0.74 ^{a-d}	0.61 ± 0.10 ^{d-g}	0.60 ± 0.11 ^{a-e}
*p-value	0.000	0.020	0.709	0.051	0.001	0.031	0.000	0.001

I₁₀₀: Full irrigation, I₅₀: 50% deficit irrigation, *: Significant distinctions among groups were observed at the P < 0.05 level, as determined by Duncan's multiple comparison test.

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243 Significant differences in Zn and Cu contents among melon genotypes and cultivars were
244 observed under both full and deficit irrigation conditions. Meanwhile, Fe content showed
245 significant differences only under full irrigation, and Mn content exhibited significance solely
246 under limited irrigation conditions (Table 7). Approximately 76% of all genotypes and cultivars
247 were adversely affected by deficit irrigation for Fe uptake, and all genotypes showed negative
248 effects on Mn uptake under deficit irrigation. In full irrigation, the highest Zn content was in
249 genotype YYU29 (238.35 ppm), and the lowest was in genotype YYU4 (47.27 ppm). Under deficit
250 irrigation, the highest Zn content was in genotype YYU29 (193.78 ppm), and the lowest was in
251 genotype cv. Napolyon (46.22 ppm). Regarding Cu content, in full irrigation, the highest was in
252 genotype YYU23 (25.82 ppm), and the lowest was in genotypes YYU25 (10.39 ppm) and YYU11
253 (10.71 ppm). Under deficit irrigation, the highest Cu content was in genotype YYU25 (14.56 ppm),
254 and the lowest was in genotype YYU10 (6.39 ppm). For Fe content, in full irrigation, the highest
255 was in genotype YYU6 (232.57 ppm), and the lowest was in genotype YYU25 (111.70 ppm). In
256 deficit irrigation, the highest Mn content was in cv. Galia (64.41 ppm), and the lowest was in cv.
257 Kirkagac (32.67 ppm).

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Table 7. Micro mineral contents in melon genotypes under full and 50% deficit irrigation.

Genotype	Zn (ppm)		Cu (ppm)		Fe (ppm)		Mn (ppm)	
	I ₁₀₀	I ₅₀	I ₁₀₀	I ₅₀	I ₁₀₀	I ₅₀	I ₁₀₀	I ₅₀
YYU1	130.26 ^{±106.20} ^{b-g}	67.01 ^{±43.97} ^{e-g}	13.63 ^{±1.06} ^{c-f}	6.81 ^{±0.89} ^{ef}	162.10 ^{±37.56} ^{b-f}	134.56 ^{±20.15}	67.29 ^{±12.60}	43.21 ^{be±8.46}
YYU4	47.27 ^{±10.28} ^g	164.38 ^{±12.30} ^{a-c}	18.63 ^{±2.39} ^b	6.61 ^{±0.04} ^{ef}	155.20 ^{±10.19} ^{c-f}	136.38 ^{±7.82}	60.74 ^{±20.91}	37.87 ^{ce±9.79}
YYU6	147.04 ^{±104.75} ^{a-f}	157.13 ^{±23.60} ^{a-d}	11.88 ^{±1.87} ^{df}	8.35 ^{±1.77} ^{c-f}	232.57 ^{±69.14} ^a	162.69 ^{±5.29}	68.66 ^{±22.35}	50.87 ^{ad±6.39}
YYU10	183.23 ^{±35.97} ^{a-e}	50.91 ^{±11.64} ^{f-g}	11.18 ^{±0.65} ^{ef}	6.39 ^{±0.42} ^f	149.46 ^{±8.51} ^{c-f}	123.35 ^{±4.33}	63.18 ^{±20.97}	39.95 ^{be±2.19}
YYU11	140.05 ^{±52.77} ^{a-g}	178.57 ^{±7.78} ^{ab}	10.71 ^{±1.13} ^f	7.09 ^{±1.19} ^{e-f}	160.95 ^{±9.29} ^{b-f}	153.55 ^{±21.76}	75.77 ^{±4.99}	40.67 ^{be±6.39}
YYU12	121.00 ^{±21.96} ^{c-g}	129.88 ^{±6.49} ^{a-f}	12.50 ^{±1.64} ^{c-f}	8.10 ^{±0.65} ^{c-f}	165.81 ^{±14.91} ^{b-f}	139.63 ^{±8.69}	73.66 ^{±23.93}	52.88 ^{ac±4.89}
YYU13	89.32 ^{±52.03} ^{e-g}	62.54 ^{±18.39} ^{fg}	14.72 ^{±2.76} ^{b-f}	6.50 ^{±2.14} ^f	185.54 ^{±4.53} ^{a-e}	141.08 ^{±7.42}	92.86 ^{±15.06}	55.40 ^{ab±8.37}
YYU14	172.39 ^{±54.82} ^{a-c}	69.13 ^{±48.34} ^{e-g}	12.00 ^{±1.45} ^{d-f}	7.48 ^{±0.93} ^{d-f}	191.18 ^{±18.82} ^{a-d}	145.41 ^{±17.35}	89.48 ^{±26.99}	47.9 ^{be±8.61}
YYU15	219.47 ^{±31.76} ^{a-c}	114.18 ^{±64.39} ^{b-g}	11.60 ^{±0.18} ^{ef}	11.10 ^{±3.17} ^{bc}	169.04 ^{±1.20} ^{b-f}	177.98 ^{±40.13}	49.98 ^{±23.99}	34.20 ^{de±1.05}
YYU18	150.62 ^{±25.86} ^{a-f}	57.85 ^{±62.04} ^{f-g}	13.00 ^{±1.26} ^{c-f}	9.33 ^{±0.35} ^{c-f}	215.94 ^{±60.01} ^{ab}	130.42 ^{±8.76}	74.21 ^{±5.87}	40.13 ^{be±4.75}
YYU20	173.19 ^{±73.28} ^{a-e}	119.20 ^{±18.38} ^{a-g}	14.24 ^{±0.90} ^{b-f}	9.11 ^{±1.63} ^{c-f}	147.46 ^{±7.77} ^{c-f}	168.24 ^{±88.29}	65.51 ^{±18.79}	39.96 ^{be±9.89}
YYU21	156.17 ^{±75.16} ^{a-f}	61.42 ^{±27.11} ^{fg}	12.70 ^{±1.44} ^{c-f}	9.40 ^{±0.14} ^{c-f}	155.61 ^{±21.06} ^{c-f}	146.78 ^{±26.75}	68.18 ^{±21.50}	46.23 ^{be±5.28}
YYU22	226.33 ^{±43.38} ^{ab}	99.74 ^{±57.25} ^{b-g}	12.92 ^{±0.41} ^{c-f}	9.78 ^{±0.26} ^{c-f}	149.75 ^{±6.44} ^{c-f}	128.18 ^{±7.89}	59.81 ^{±5.89}	34.77 ^{de±3.16}
YYU23	57.31 ^{±1.51} ^{fg}	99.26 ^{±18.13} ^{b-g}	25.82 ^{±7.49} ^a	7.68 ^{±1.95} ^{c-f}	128.97 ^{±5.14} ^{ef}	101.85 ^{±39.90}	81.25 ^{±17.10}	44.03 ^{be±18.17}
YYU25	96.00 ^{±24.49} ^{d-g}	86.00 ^{±83.82} ^{c-g}	10.39 ^{±2.05} ^f	14.56 ^{±4.35} ^a	111.70 ^{±39.83} ^f	134.48 ^{±17.05}	57.89 ^{±33.99}	44.84 ^{be±8.36}
YYU29	238.35 ^{±23.15} ^a	193.78 ^{±1.36} ^a	12.84 ^{±3.13} ^{c-f}	10.72 ^{±2.58} ^{b-d}	142.19 ^{±8.77} ^{d-f}	117.36 ^{±4.07}	88.90 ^{±11.45}	41.48 ^{be±9.41}
YYU30	217.16 ^{±15.01} ^{a-c}	78.90 ^{±55.14} ^{d-g}	16.02 ^{±0.58} ^{b-c}	9.25 ^{±0.98} ^{c-f}	206.30 ^{±55.75} ^{a-c}	139.05 ^{±48.08}	95.26 ^{±30.12}	42.74 ^{be±6.74}
Galia	95.83 ^{±23.83} ^{d-g}	144.02 ^{±29.03} ^{a-e}	14.25 ^{±1.13} ^{b-f}	11.09 ^{±1.86} ^{bc}	181.86 ^{±21.21} ^{a-e}	219.30 ^{±70.51}	98.72 ^{±22.67}	64.41 ^{a±16.84}
Kirkagac	148.50 ^{±72.15} ^{a-f}	52.6 ^{±17.37} ^{f-g}	12.62 ^{±2.11} ^{c-f}	8.43 ^{±0.62} ^{c-f}	137.45 ^{±25.57} ^{d-f}	150.76 ^{±35.76}	59.58 ^{±5.41}	32.67 ^{be±1.86}
Lokum	185.73 ^{±9.31} ^{a-e}	146.74 ^{±79.52} ^{a-e}	17.03 ^{±2.03} ^{bc}	10.17 ^{±1.11} ^{c-e}	169.38 ^{±35.88} ^{b-f}	136.44 ^{±14.47}	54.66 ^{±26.67}	39.72 ^{be±11.90}
Napolyon	194.65 ^{±3.52} ^{a-d}	46.22 ^{±7.29} ^g	16.69 ^{±4.49} ^{b-d}	13.96 ^{±3.15} ^{ab}	159.86 ^{±13.59} ^{b-f}	143.42 ^{±16.24}	58.99 ^{±15.33}	35.18 ^{de±2.30}
*p-value	0.001	0.000	0.000	0.000	0.002	0.094	0.144	0.008

I₁₀₀: Full irrigation, I₅₀: 50% deficit irrigation, *: Significant distinctions among groups were observed at the P < 0.05 level, as determined by Duncan's multiple comparison test.

Enzyme Activation and MDA Content

CAT activity significantly increased under deficit irrigation, indicating a response to water stress. APX activity increased across all melon genotypes and cultivars in deficit irrigation, with significant differences found only in the full irrigation group (Table 8). SOD enzyme activity increased with deficit irrigation, and MDA content increased in 76% of genotypes, yet no significant differences were observed among genotypes and cultivars in full and restricted irrigation applications. CAT activity in melon genotypes showed a 57.14% decrease under deficit irrigation-induced water stress. The genotype YYU25 exhibited the highest CAT content (0.104 mmol g⁻¹ FW), followed by cv. Kirkagac (0.086 mmol g⁻¹ FW), and then genotypes YYU14, YYU23, YYU29, YYU30, and cv. Lokum (0.040-0.040 mmol g⁻¹ FW). Other melon genotypes and cultivars displayed lower CAT content. In full irrigation, the highest APX content was in genotype YYU4 (0.714 mmol g⁻¹ FW), while the lowest Fe content was in genotype YYU29 (0.152 mmol g⁻¹ FW).

Table 8. Enzyme Activation and MDA Content in Melon Genotypes under Full and 50% Deficit Irrigation.

Genotip	CAT (mmol g ⁻¹ FW)		SOD (U mg ⁻¹ FW)		APX (mmol g ⁻¹ FW)		MDA (μmol g ⁻¹ FW)	
	I ₁₀₀	I ₅₀	I ₁₀₀	I ₅₀	I ₁₀₀	I ₅₀	I ₁₀₀	I ₅₀
	YYU1	0.052±0.023	0.004±0.002 ^c	82.68±45.60	274.48±223.88	0.393±0.287 ^{a-f}	1.101±0.352	2.624±0.711
YYU4	0.013±0.010	0.015±0.007 ^c	83.86±27.82	312.28±69.96	0.714±0.245 ^a	1.548±0.267	3.570±1.273	3.355±1.419
YYU6	0.110±0.006	0.017±0.017 ^c	104.33±16.83	267.38±141.04	0.571±0.161 ^{a-d}	1.313±0.180	3.140±0.521	2.968±1.677
YYU10	0.023±0.011	0.005±0.005 ^c	103.33±13.33	252.12±85.92	0.506±0.037 ^{a-e}	1.077±0.172	4.000±0.785	6.194±1.707
YYU11	0.069±0.006	0.030±0.025 ^c	98.72±17.95	167.02±40.83	0.473±0.045 ^{a-f}	1.393±0.179	4.430±0.521	5.548±1.359
YYU12	0.076±0.069	0.024±0.033 ^c	103.28±32.44	266.15±23.56	0.670±0.143 ^{ab}	1.411±0.240	5.129±0.581	6.409±1.171
YYU13	0.076±0.019	0.015±0.025 ^c	89.35±8.10	393.65±240.29	0.586±0.163 ^{a-c}	1.113±0.552	4.710±0.281	4.903±1.617
YYU14	0.027±0.015	0.048±0.017 ^{bc}	93.61±11.23	156.78±111.66	0.571±0.093 ^{a-d}	1.060±0.435	3.828±1.659	3.484±0.930
YYU15	0.035±0.039	0.036±0.009 ^c	98.53±4.35	336.39±123.65	0.429±0.227 ^{a-f}	0.887±0.627	5.355±0.091	3.484±1.466
YYU18	0.037±0.018	0.024±0.012 ^c	99.85±66.69	180.90±80.44	0.458±0.135 ^{a-f}	1.083±0.318	5.376±1.624	7.312±5.099
YYU20	0.095±0.071	0.013±0.015 ^c	91.81±39.10	222.62±132.01	0.345±0.220 ^{b-f}	1.131±0.530	4.301±0.878	5.118±1.496
YYU21	0.050±0.022	0.017±0.027 ^c	100.39±16.92	273.18±162.02	0.232±0.107 ^{ef}	1.113±0.072	4.086±0.269	6.323±2.323
YYU22	0.014±0.015	0.026±0.029 ^c	118.53±49.18	272.22±39.15	0.440±0.213 ^{a-f}	1.238±0.438	5.505±2.168	7.785±7.254
YYU23	0.052±0.051	0.040±0.019 ^{bc}	116.63±85.74	294.33±121.03	0.369±0.021 ^{b-f}	1.298±0.254	5.591±1.871	4.817±2.831
YYU25	0.053±0.002	0.104±0.084 ^a	118.31±38.39	339.11±286.34	0.268±0.263 ^{c-f}	0.839±0.568	3.656±0.197	4.430±0.711
YYU29	0.042±0.059	0.047±0.005 ^{bc}	105.19±33.61	360.50±64.62	0.152±0.116 ^f	1.262±0.332	3.613±1.359	4.860±0.662
YYU30	0.055±0.048	0.044±0.004 ^{bc}	129.06±70.78	398.75±163.67	0.304±0.000 ^{c-f}	0.702±0.320	4.344±0.537	4.473±1.844
Galia	0.033±0.018	0.015±0.020 ^c	118.38±37.70	471.32±347.81	0.423±0.297 ^{a-f}	0.857±0.295	3.269±0.649	3.699±1.171
Kirkagac	0.045±0.016	0.086±0.029 ^{ab}	82.94±43.06	135.11±38.43	0.232±0.125 ^{ef}	0.774±0.260	4.645±0.683	5.677±3.307
Lokum	0.093±0.127	0.050±0.030 ^{bc}	101.74±22.80	230.04±200.48	0.411±0.054 ^{a-f}	0.792±0.115	3.441±0.778	5.204±3.492
Napolyon	0.040±0.054	0.022±0.013 ^c	86.56±13.04	412.12±243.99	0.244±0.108 ^{d-f}	1.268±0.189	3.656±2.086	6.538±3.662
*p-value	0.472	0.003	0.995	0.606	0.005	0.481	0.074	0.658

I₁₀₀: Full irrigation, I₅₀: 50% deficit irrigation. *: Significant distinctions among groups were observed at the P< 0.05 level, as determined by Duncan's multiple comparison test.

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Principle Component (PCA) and Cluster Analysis

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Eigenvalues and variances resulting from PCA elucidated the contributions of traits (PCA loads) causing distinctions in deficit irrigation. In the analysis encompassing 28 traits, the first six components with Eigenvalues exceeding 1.00 collectively explicated 77.91% of the total variation (Table 9). PC1 (32.36%) was primarily influenced by APX, SFW, RFW, SDW, 0-5 scale, and Mn content. PC2 (15.39%) was characterized by leaf number, shoot diameter, shoot length, RDW, R/S, and Cu content. PC3 (11.32%) featured stoma length, stoma width, and stoma area as prominent contributors. PC4 (8.77%) revealed the significance of RDM, K, Ca, Mg, and Fe contents. PC5 (5.73%) and PC6 (4.34%) portrayed the importance of MDA, SDM, and P content in the former, while CAT, SOD, stoma density, root length, and Zn content were crucial in the latter (Table 9).

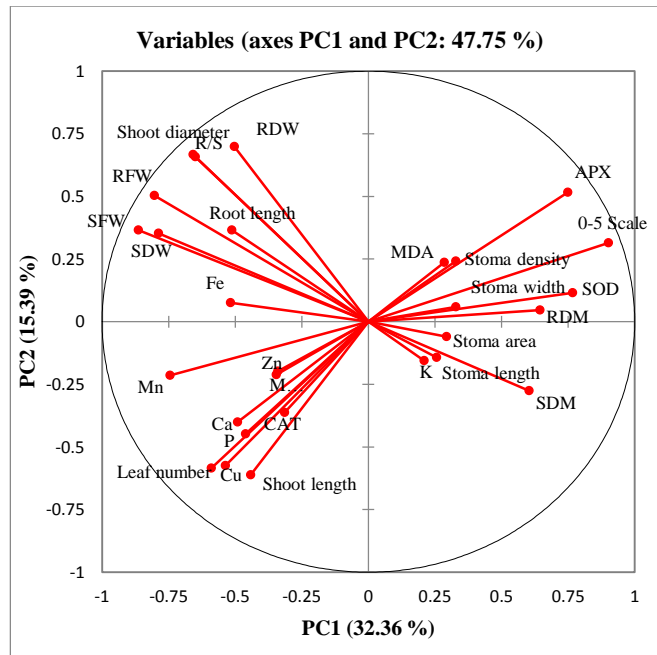
Table 9. PCA loads of the investigated properties in deficit irrigation.

	PC1	PC2	PC3	PC4	PC5	PC6
Eigenvalues	9.06	4.309	3.17	2.46	1.61	1.21
Explained proportion of variation (%)	32.36	15.39	11.32	8.77	5.73	4.34
Cumulative proportion of variation (%)	32.36	47.75	59.07	67.84	73.57	77.91
Factors (Eigen Vectors)						
CAT	-0.105	-0.174	0.012	0.010	0.066	0.403
SOD	0.255	0.055	0.051	0.027	-0.089	-0.314
APX	0.249	0.249	-0.063	0.070	-0.067	-0.091
MDA	0.109	0.116	0.206	-0.128	0.450	-0.048
Stoma length	0.069	-0.075	0.452	-0.235	-0.124	-0.078
Stoma width	0.109	0.029	0.460	0.018	-0.138	0.161
Stoma area	0.097	-0.029	0.507	-0.107	-0.142	0.054
Stoma density	0.095	0.114	-0.202	0.186	0.085	0.567
Leaf number	-0.196	-0.282	-0.006	-0.234	0.122	-0.137
Shoot diameter	-0.216	0.317	0.004	0.005	-0.058	-0.018
Shoot length	-0.147	-0.295	-0.095	-0.234	0.156	-0.095
Root length	-0.170	0.176	0.085	0.106	0.072	-0.212
SFW	-0.287	0.176	-0.016	-0.093	-0.031	-0.106
RFW	-0.267	0.242	0.051	-0.071	0.057	0.034
SDW	-0.262	0.170	0.026	-0.158	0.170	-0.051
RDW	-0.167	0.337	0.179	0.039	0.171	0.062
SDM	0.200	-0.133	0.115	-0.010	0.420	0.141
RDM	0.214	0.022	0.203	0.249	0.142	0.011
R/S	-0.219	0.321	0.096	0.064	-0.055	-0.025
0-5 Scale	0.299	0.152	-0.011	0.006	0.010	-0.085
K	0.085	-0.069	-0.131	0.445	-0.105	-0.261
Ca	-0.163	-0.193	0.138	0.368	0.171	-0.152
Mg	-0.113	-0.095	0.209	0.447	0.237	-0.027
P	-0.153	-0.216	0.093	0.119	-0.352	-0.175
Cu	-0.178	-0.277	0.025	-0.004	0.160	-0.042
Fe	-0.172	0.037	0.018	0.251	-0.079	0.074
Mn	-0.247	-0.103	0.146	0.199	-0.006	0.104
Zn	-0.115	-0.102	0.102	0.000	-0.396	0.335

304 SFW: Shoot fresh weights, RFW: Root fresh weights, SDW: Shoot dry weight, RDW: Root dry weight, SDM: Shoot
305 dry matter, RDM: Root dry matter, R/S: Root-to-shoot ratio (dry weight %).
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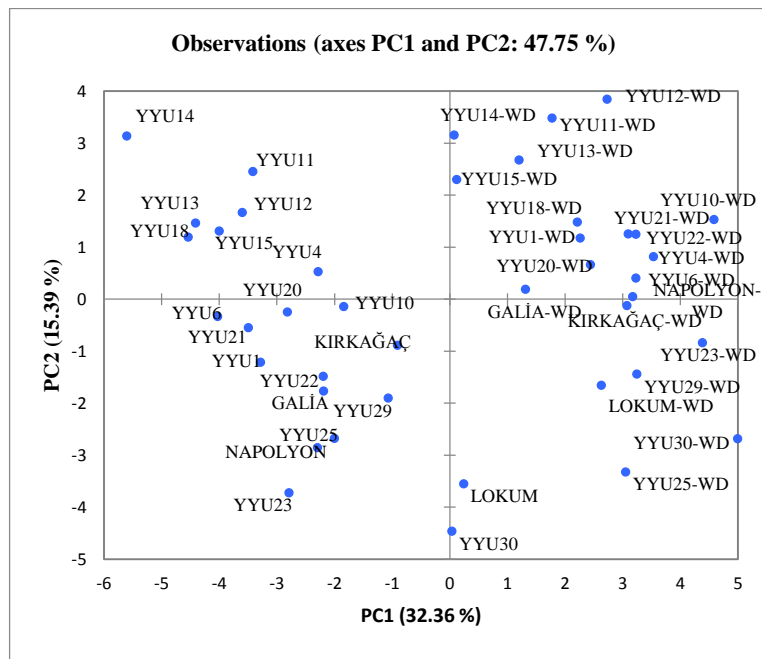
307 A loading plot, derived from the initial two components (PC1 and PC2), elucidated the intricate
308 relationships among the 28 examined traits (Figure 1). A corresponding score plot, integrating PC1
309 and PC2 components, effectively depicted the impact of deficit irrigation (Figure 2). Notably, a
310 clear demarcation was observed between full and deficit irrigation applications, with a propensity
311 for close proximity. Additionally, in the deficit irrigation application, genotypes YYU25 and
312 YYU29 were discernibly positioned in the positive regions of both PC1 and PC2. These findings
313 underscore the nuanced interplay of traits under deficit irrigation conditions, shedding light on the
314 pivotal role of certain genotypes in this context.

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Figure 1. PCA Loading plot of study traits using first two principal components.



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320 **Figure 2.** Melon Genotypes/Cultivars under Full and 50% Deficit Irrigation Conditions (-WD
321 Suffix) Mapped on PCA Score Plot.
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323 DISCUSSION

324 Water scarcity poses a significant challenge to agriculture, impacting crop productivity and yield.
325 Deficit irrigation (DI), a water conservation strategy, influences physiological and yield traits in

326 crop genotypes. The response to DI varies across species and cultivars, emphasizing the importance
327 of understanding this variability for effective water management. Studies on upland cotton
328 (Matniyazova et al., 2022) and muskmelon (Pandey et al., 2018) underscored the significance of
329 genetic variability in drought tolerance traits, suggesting the potential for developing drought-
330 tolerant cultivars. Similarly, the present study on melon revealed varying responses among
331 genotypes and cultivars to deficit irrigation.

332 The observed fluctuations in parameters indicate both positive and negative impacts of stress.
333 Notably, SDM and RDM, stomatal width, stomatal density, K, APX, SOD enzymes, and MDA
334 increased, while other parameters (shoot and root length, stem diameter, leaf number, shoot fresh
335 and drsy weight, root fresh and dry weight, stoma height and area, Mg, Ca, P, Zn, Cu, Fe, Mn and
336 CAT) decreased. Overall, deficit irrigation adversely affected plant growth, aligning with the
337 common response of decreased growth rate and visible stress symptoms (Dasgan et al., 2002;
338 Cakmakci et al., 2022b). Genotypic variations were evident in the reduction of leaves, shoot length,
339 shoot diameter, root length, SDW, RFW, and RDW under stress. The root system, crucial for water
340 uptake, suffered significant decreases, likely impacting water retention and, consequently, plant
341 survival.

342 Root length, a key indicator of drought avoidance, was negatively affected, aligning with studies
343 emphasizing the importance of a long root system in drought tolerance (Serraj et al., 2004). The
344 study implies that decreased root length results from stress-induced damage to cell growth and
345 division. The effects of DI on root growth have been reported, suggesting stimulation of root
346 growth and improved water use efficiency (Costa et al., 2007).

347 A notable finding is the increase in SDM and RDM ratio under stress, indicating better water-
348 holding capacity in more stress-tolerant plants. This aligns with the notion that higher water-
349 holding capacity correlates with better drought tolerance. However, such changes in dry matter
350 ratios may also be indicative of osmotic stress (Kravić et al., 2013). The negative impact of stress
351 on the nutritional status of plants was evident, with decreases in P, Ca, Mg, Zn, Cu, Fe, and Mn
352 uptake, except for a 67% increase in K uptake. Potassium, vital for osmoregulation and enzyme
353 activation, demonstrated an increased role under stress, potentially maintaining osmotic balance.
354 The observed decrease in Ca uptake aligns with reports of limited mobility in the phloem,
355 restricting Ca transport under water limitation (Hessini et al., 2009; Kiegle et al., 2000).

356 Enzyme activities showed a nuanced response, with a 57.14% decrease in CAT activity and
357 increased SOD and APX activities in genotypes under water stress. Antioxidative enzymes, crucial
358 during stress, are stimulated to defend against stress. The elevated MDA content in 76% of
359 genotypes suggests cell membrane damage under stress conditions. One of the most important
360 effects of water shortage stress is the decrease in plant nutritional elements and the other is the
361 damage to the cell walls. Malondialdehyde (MDA), as an indicator of oxidative damage caused by
362 water shortage stress, increased in the leaf tissues of all melon genotypes in the experiment after
363 the stress application (Kırathı et al. 2015). In melon, it was determined that the amount of MDA in
364 the leaves of drought-stressed plants was significantly higher than in control plants (Kusvuran
365 2010). SOD, CAT, GR, APX enzyme activities are stimulated under drought stress conditions
366 (Mohammadkhani and Heidari 2007; Bahadur et al., 2011; Fghire et al., 2013). In this study, the
367 results of which were given, increased enzyme activities such as SOD and APX occurred due to
368 stress factor and injury. It has been determined that these increases are at varying rates. Sources
369 point out that increases in enzyme activation may have an effective role in establishing drought
370 tolerance of genotypes (Kıran et al. 2015). MDA levels have been linked to plant stress responses,
371 varying across species and varieties. The findings align with other studies reporting increased MDA
372 content under drought stress (Sevengor et al., 2011; Sánchez-Rodríguez et al., 2010; Keling et al.,
373 2013), highlighting the variability in stress responses.

374 PCA analysis effectively elucidated stress-induced variations, explaining 47.75% of the total
375 variation. The differentiation among irrigation regimes and mycorrhizal inoculum in melon plants
376 further emphasizes the importance of selecting appropriate parameters for discriminating among
377 treatments. The relationship between vectors, as illustrated in Figure 1, provides insights into the
378 positive correlation within certain growth and physiological parameters. The study concludes by
379 emphasizing the complexity of plant responses to deficit irrigation and the need for tailored
380 approaches to mitigate the impact of water stress on crop productivity.

381 382 **CONCLUSIONS**

383 Global challenges like population growth and environmental issues demand sustainable solutions
384 in agriculture. Deficit irrigation (DI) stands out as an effective water-saving strategy for melon
385 production, but its impact varies among plants. Genetic diversity plays a crucial role in developing
386 drought-tolerant cultivars, a key focus in breeding programs. The study, conducted in the Lake Van

387 Basin, highlights variations in melon genotypes' responses to deficit irrigation. Promising
388 genotypes, selected for traits like seedling development and ion balance, show potential for future
389 breeding programs, enhancing fruit quality and sustainability. In summary, addressing water
390 scarcity requires leveraging genetic diversity and tailored breeding efforts. The identified
391 genotypes offer promising prospects for sustainable agriculture in water-scarce regions like the
392 Lake Van Basin.

393

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