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**Araştırma Makalesi / Research Article**

# The Morphological Response of 127 Durum Wheat (*Triticum turgidum* ssp *durum*) Genotypes against Salt Stress at Germination Stage

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**Abstract**

Salinity is one of the environmental problems and has adverse effects on plants. In this study, it was aimed to investigate the effects of different salt concentrations on 127 durum wheat (*Triticum turgidum* ssp durum) genotypes at the germination stage. For this purpose, wheat seeds were germinated in Petri dishes for12 days, and 0-50-100 and 200 mM NaCl solutions were applied. Increasing salinity caused reduction of germination, coleoptile length, shoot dry matter, and root length. The results showed increasing salinity concentrations inhibited durum wheat growth at germination stage. In the highest salt concentration C9, Akçakale-2000, and Vatan genotypes were found the most tolerant; and Zenit, Çeşit-1252, and Şölen-2002 weredetermined asthe most sensitive genotypes; so according to these results. C9, Akçakale-2000, and Vatan genotypes are the cultivars to be advised for salty soils.

**Keywords:** Durum wheat, salinity, germination, coleoptile

## 1. Introduction

Wheat, is a primary individual of Poaceae family and and this genus named '*Triticum*' (Chen et al.,2020). It has three species which have different chromosome numbers: *T. monococcum* (diploid), *T. durum* (tetraploid) and (hexaploit) (Özkan and Genç,1998). It is a fundamental cereal crop for many people since it provides protein and carbohydrates (Talaat and Shawky, 2014); and and after maize, wheat is the second most grown cereal crop (Datta et al., 2009). Durum wheat which evolved from a wild tetraploid species of *Triticum (T. dicoccoides*), is the main raw material of pasta, bulgur, couscous and semolina (Bouthour et al., 2015; Kadkol and Sissons, 2016). It is a traditional Mediterranean crop and originated in the Fertile Crescent (Soriano et al., 2016). Plants are importance organisms due to their sunlight conversion ability to chemical energy. Optimum environmental conditions are necessary for taking maximum yield from plants. However, plants usually under the influence of different negative exogenous factors named 'stress'. Stress factors affect wheat plants in different ways; for example heat stress decreases its productivity (Poudel et al.,2021), drought stress causes oxidative damage (Naz et al.,2021) and cadmium stress reduces the growth and pigment content (Liu et al.,2021). Also because of climate change and lack of precipitation salinity is becoming a important stress factor, which affects durum wheat, too (Soni et al., 2021a). Salinity is a major stress factor and an example of chemical stress that limits germination, growth, and productivity of plants (Sairam et al., 2002; Talaat and Shawky, 2014; Saleh and Madany, 2015). According to FAO Soil Portal data, 397.1 hectare of Earth lands (means 3,1%) is salty. Salinity means the high concentration of soluble salts. Soils, of which conductivity higher than fourds/m, classified as 'salty' and this value equals 40 mM sodium chloride (NaCl) that creates 0,2 MPa osmotic pressure (Munns and Tester, 2008, USDA-ARS, 2008). When salinity exceeds this value and soil pH higher than 8.5, productivity begins decreasing (Sairam ve ark., 2002). The paucity of precipitation, excessive irrigation, and applied fertilizers are the main factors of salinity (Tester and Davenport, 2003; Radhakkrishnan and Lee, 2015). Salinity tolerance shows the difference among plants. For example, paddy (*Oryza sativa)* is the most sensitive cereal while barley (*Hordeum vulgare)* is the most tolerant among cereals. Breadwheat *(Triticum aestivum)* is mid tolerant nevertheless durum wheat (*Triticum turgidum ssp. durum*)'s tolerance is less than bread wheat. Halophyte monocotyledon and relative of wheat *Agropyron elegantum* is one of the most tolerant plants against salt as it maintains life at salt concentrations like seawater (Munns ve Tester, 2008). Salinity caused membran disruption, decraesing soluble suger concentration, and increasing proline, protein, root-shoot Na/K rate and antioxidative enzyme (SOD, CAT, POX and APX) activities in durum wheat genotypes (Soni et al.,2021b). Also, Bouthour et al (2015) found that salinity caused growth inhibition and and decreasing chlorophyl content in two different durum wheat cultivars. This paper reports a salinity evaluation of durum wheat genotypes from different groups. The scopes of this paper are 1) to research the impact of salinity on wheat genotypes at germination and first twelve days of vegetative stage, 2) to select sensetive and tolerant genotypes of groups against salinity.

## 2. Materials and Methods

### 2.1 Plant materials

A collection of one hundred and twenty seven*Triticum turgidum* ssp. *durum* genotypes and cultivars from different groups (Turkish 50; foreign 20; genebank 43 and growing 14 genotypes; given in addition file) was used in this study. The seeds of genotypes were obtained Cukurova University Department of Field Crops.

### 2.2 Germination and salt applications

The experiments were conducted at controlled environmental conditions in Plant Physiology Laboratory, Department of Biology, Çukurova University, in 2016. Surface sterilisation of the seeds were done with 5% commercial sodium hypochlorite solution for ten minutes and rinsed with distilled water (Kamran et al.,2009).25 seeds of each genotype were placed between moist general purposed filter papers in a glass Petri dish (90 mm*20 mm). The seeds were treated with 0 (as control, only distiled water)- 50-100 and 200 mM NaCl. The electrical conductivity of distilled water, 50-100 and 200 mM NaCl solutions suspended to 168.9 µS/cm, 4.93 mS/cm, 9.46 mS/cm ve 17.88 mS/cm, in turn.. Petri dishes were kept under dark conditions first three days, later at 24/20±2ºC day/night tempetarute, 16/8 light/dark photoperiod (Bouthour et al.,2015), and 60±5% humidity, in a controlled climate room. After three days of sowing, the seedlings of which both-radicula and plumula lengths reached 2 mm were counted as germinated (Ehtaiwesh,2016). Also coleoptile lengths of randomly selected five seedlings from each petri were measured with a ruler. Seedlings were harvested twelve days later of sowing. Four seedlings were randomly selected from each petri, then their root-shoot length and fresh weights were measured. Following these, all samples were dried in an oven at 65°C until constant dry weight (Kamran et al.,2009) and data were recorded. Germination rate (percentage) of the seeds was calculated according to the following formula (Çarpıcı et al.,2009). Germination percentage (%) = (Number of germinated seeds/number of total seeds) * 100

### 2.3. Analysis of Data

Data wereevaluated with STAR statistic programme (Statistical Tool for Agricultural Research; Gulles et al.,2014) and variance analysis was done. Also, to evaluate the effects of salinity on durum wheat cultivars, rating method of Turan (2012) was used with some modifications. For this purpose, the percent change between the highest salinity concentration and control values was calculated. The genotype which had the highest percent change was scored with the lowest point 1. Also the genotype that had the lowest percent change was scored with the highest point 127 (due to 127 genotype). This calculation was done for germination rate, coleoptile length, root lenghth and shoot dry matter parameters and then whole points of genotypes were added. Finally, the genotypes which had high points were accepted as resistant and the genotypes had low points accepted as sensitive.

## 3. Results and Discussion

The results of the variance analysis of the germination rate of 127 durum wheat genotypes grown in different salt concentrations in petri dishes are given at Table 1. According to this, the interaction of salt concentration, genotype, salt concentration x genotypewas found significant at $p<0.01$significance level.

**Table 1**.Analysis of variance for effect genotypes and salt concentrations on germination rates of 127 durum wheat genotypes

| Germination Rate | | | | |
|---|---|---|---|---|
| Source | DF | Sum of Square | Mean Square | F value |
| Salt concentration | 3 | 20769,0 | 6923,0 | 73,4** |
| Error (a) | 12 | 1131,3 | 94,3 | |
| Genotype | 126 | 160039,2 | 1270,2 | 15,5** |
| Salt concentrationx genotype | 378 | 46956,0 | 124,2 | 1,5** |
| Error (b) | 1512 | 124312,7 | 82,2 | |
| Total | 2031 | 353208,2 | | |

DF: Dergee of freedom; * and ** significant at 5% and 1%, respectively.

Germination rates of the whole genotypes are shown at the Table 5 and it is seen that the germination rate decreases with the increasing salt concentrations. Feghhenabi et al. (2020) declared similar results to our study by applying different concentrations of salt solutions by diluting the salty lake water to the seeds of bread wheat (*Triticum aestivum* L.) and found that the germination percentage decreased with increasing salinity. Mean germination rates were found 83.6% at control plants, 81.7% at 50 mM, 80.2% at 100 mM and 75% at 200 mM salinity concentrations. Zhang et al.(2013), found the lowest germination rates of different oat (*Avena sativa* L.) cultivars against different salinity concentrations in the highest salt concentration.In addition, as seen in Table 5, the highest germination rate in the control application (0 mM salt) was in Dumlupınar (Genotype No 7) and Balcalı 85 (GN 16) genotypes, in the Dumlupınar genotype with 50 and 100 mM salt application, the highest concentration was at 200 mM, it was detected in the Kurtulan (GN119) genotype. The lowest germination rates were determined in control, Gökgöl 79 (G.N.38) in 50 mM salt application, Inbar (G.N.63) in 100 mM salt application and Gökgöl 79 (G.N.38) genotype with the highest concentration of 200 mM salt application. When genotype groups (Turkish, foreign, genebank and growing genotypes) were examined, it was found that the groups showed a similar tendency to increase salt concentration. The mean germination of the groups at whole concentrations are seen at Figure 1. Also, the % change of the highest salt concentration compared to the control is shown in the figure. A decrease was found 9% in Turkish genotypes; while 11% was found at other three genotypes.

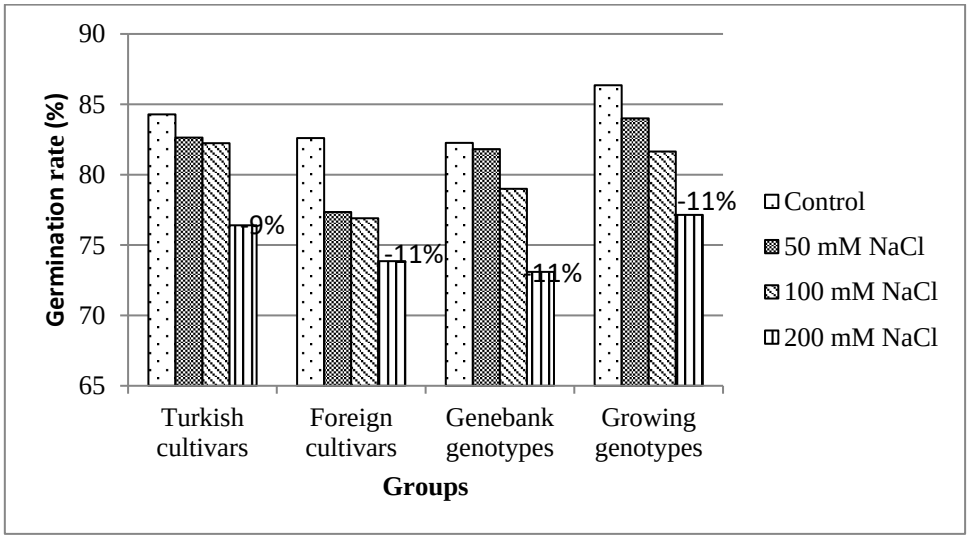


**Figure 1.** The effects of salt concentrations on different groups' germination rates (the numbers represents % change of the highest salt concentration compared to the control)

Seed germination and early seedling growth were declared as important stages in the plant lifecycle, and have been stated to affect the yield (Ahammed,2020). These stages have also been stated as the most sensitive to salinity. Delay or inhibition of the germination with salinity were attributed to the reduction in water availability, the changes at transport of stored products and structural adjustment of proteins (Ibrahim, 2016). The variance analysis showed that, the interaction of salt concentration, genotype, salt concentration x genotypewas found significant at $p<0.01$ importance level (Table 2) for coleoptil length parameter.

**Table 2**. Analysis of variance for effect genotypes and salt concentrations on coleoptil lengths of 127 durum wheat genotypes

| | Coleoptile length | | | |
|---|---|---|---|---|
| Source | DF | Sum of Square | Mean Square | F value |
| Salt concentration | 3 | 416847,2 | 138949,1 | 3212,8** |
| Error (a) | 16 | 692,0 | 43,2 | |
| Genotype | 126 | 181494,7 | 1440,4 | 28,1** |
| Salt concentration x genotype | 378 | 58307,2 | 154,3 | 3,0** |
| Error (b) | 2016 | 103244,8 | 51,2 | |
| Total | 2539 | 760585,9 | | |

DF: Dergee of freedom; * and ** significant at 5% and 1%, respectively.

Mean coleoptile lengths of whole durum wheat genotypes are given in the Table 5. Average coleoptile lengthof control plants was found 59 mm; also respectively 55, 45 and 26mm at increasing salinity concentrations. Similar results were found in Öner and Kırlı (2018)'s study. Coleoptile length of different wheat varieties *(Triticum aestivum* L.) showed a decreasing trend in increasing salinity concentrations and the lowest coleoptile length was found in the highest salt test in all varieties. The highest coleoptile length in control plants was determined in TR 81284 –Ankara (G.N.104) genotype (shown in Table 5); also in TR 47949 –Kars (G.N.84), TR 31902 –Malatya (G.N.99) and Menceki (G.N.115) genotypes with salinity applications (50-100 and 200 mM). The lowest coleoptile length in control application was measured in Gap (G.N.45); in 50 mM salinity in Güney yıldızı (G.N.32), in 100 mM and 200 salinity concentrations in Dumlupınar (G.N.7) genotypes. It is reported that coleoptile elongation was inhibited against salinity as a result of the application of 100 mM NaCl to two different bread wheat (*Triticum aestivum* L.) varieties, and coleoptile length could be used in determining salt-tolerant varieties (Fang et al.,2010). When genotype groups were evaluated, four groups have had approximate values. In the highest salinity concentration, Turkish cultivars decreased coleoptil length 59% and affected more than others, as shown in Figure 2.

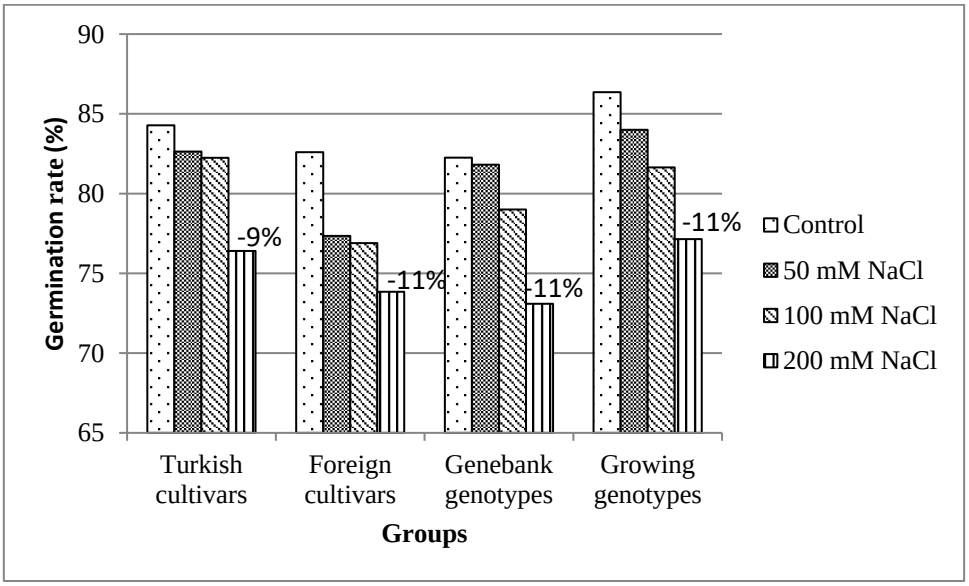


**Figure 2.** The effects of salt concentrations on different groups' coleoptile lengths (the numbers represents % change of the highest salt concentration compared to the control)

Satish et al. (2016) examined the histochemical structure of the finger millet (*Eleusine coracana* (L.) Gaertn) coleoptyl belonging to the Poaceae family in response to salinity, and it was reported that the leaf water potential decreases against increasing salt concentrations, and the increased lignin accumulation in the cells may cause changes in the cell wall, also this situation may cause changes in the cell elongation, as a result of these may lead to morphological changes. Considering that these morphological changes may affect length firstly, so decrease in coleoptile height can be attributed to these cellular changes. Variance analysis of the durum wheat genotypes'shoot dry matter of is shown in Table 3. With reference to this table, the interaction of salt concentration, genotype, salt concentration x genotype was found significant at $p<0.01$ importance level.

**Table 3**. Analysis of variance for effect genotypes and salt concentrations on shoot dry weights of 127 durum wheat genotypes

| | Shoot dry weight | | | |
|---|---|---|---|---|
| Source | DF | Sum of Square | Mean Square | F value |
| Salt concentration | 3 | 386587,6 | 128862,5 | 395,5 ** |
| Error (a) | 12 | 3910,0 | 325,8 | |
| Genotype | 126 | 467411,8 | 3709,6 | 24,4** |
| Salt concentration x genotype | 378 | 132375,8 | 352,2 | 2,3** |
| Error (b) | 1512 | 230331,9 | 152,3 | |
| Total | 2031 | 1220617,0 | | |

DF: Dergee of freedom; * and ** significant at 5 % and 1 %, respectively.

Durum wheat genotypes' whole mean shoot dry matter are shown in Table 5. Accordingly, mean values were found 91 mg in control plants, 95, 87 and 60 with increasing salinity Similarly, two different research groups found a increase in shoot growth against low salt concentrate (50 mM salinity) in two of three different durum wheat cultivar, and reduction in higher concentrations (Almansouri et al.,1999 and Yıldırım et al.,2015). Munns and Gilliham (2015) stated that plants make osmotic adjustments by synthesizing compounds at the cellular level to occur salt tolerance mechanism. In other words, the increase in weight against low salt concentration may be due to the genotypes'protect their turgormechanism by synthesizing osmolyte to protect its turgor and increase their water holding capacity. In the present results, the highest shoot dry matter was ascertained in Eminbey (G.N.10) genotype in control plants; 81381 -Sivas (G.N.79) in 50 mM salinity, Gündaş (G.N.36) and Özberk (G.N.41) in 100 and 200 mM salinity. The lowest values were found in Selçuklu 97 (G.N.24) in control application, Şölen 2002 (G.N.8) in 50 and 100 mM salinity; Meram 2002 (G.N.6), Dumlupınar (G.N.7) and Şölen 2002 (G.N.8) in 200 mM salinity. When genotype groups were examined, it was determined that the groups demonstrated similardisposition to increasing salinity. The averageshoot dry weights of the groups at whole concentrations are seen at Figure 3. In the highest salinity concentration, gene bank and growing genotypes were found more tolerant with 29% decrease.

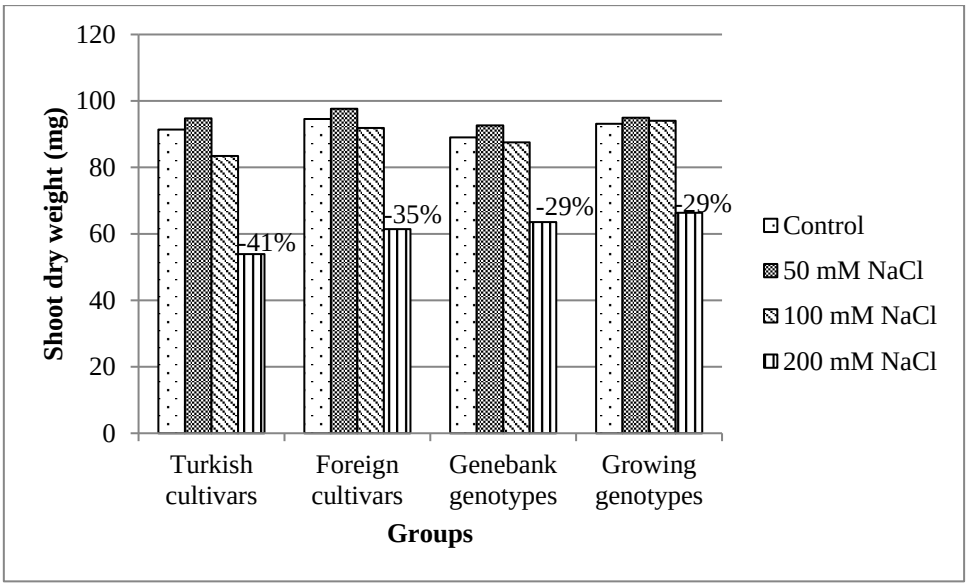


**Figure 3.** The effects of salt concentrations on different groups' shoot dry weights (the numbers represents % change of the highest salt concentration compared to the control)

Hasegawa et al. (2000) expressed that, salinity may be destroyed membrane integrity and reduced photosynthesis. Photosynthesis, is an important mechanism that determines plant dry matter needs water, so the inhibition of water uptake with salinity causes water shortage, damages photosynthesis and brings about impediments in dry matter accumulation of genotypes.

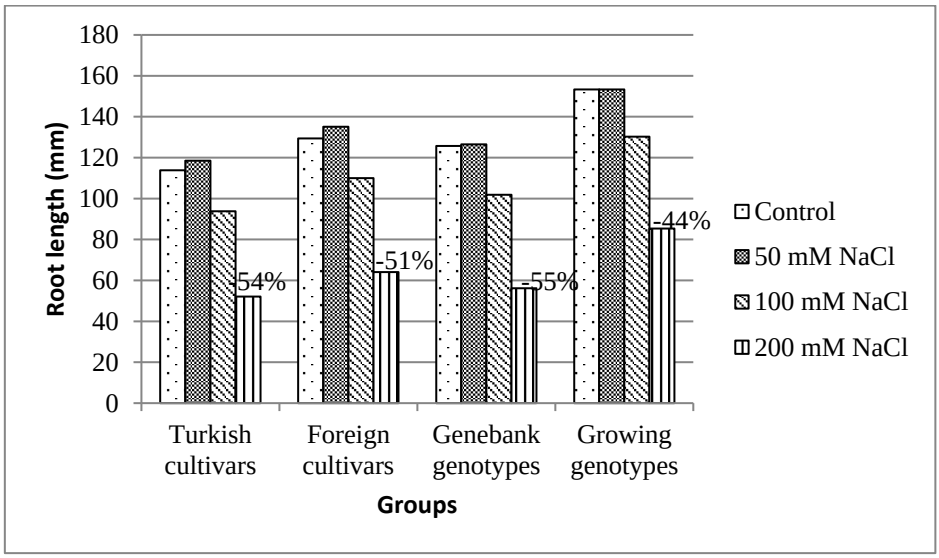


**Figure 4** The effects of salt concentrations on different groups' root lengths (the numbers represents % change of the highest salt concentration compared to the control)

The results of the variance analysis of the root lengths of durum wheat genotypes grown against salt concentrations are shown in Table 4. According to this, the interaction of salt concentration, genotype, salt concentration x genotype was found significant at $p<0.01$ importance level

**Table 4.**Analysis of variance for effect genotypes and salt concentrations on root lengths of 127 durum wheat genotypes

| | Root length | | | |
|---|---|---|---|---|
| Source | DF | Sum of Square | Mean Square | F value |
| Salt concentration | 3 | 9180082,0 | 3060027,3 | 4464,9** |
| Error (a) | 92 | 63051,9 | 685,4 | |
| Genotype | 126 | 6327447,0 | 50217,8 | 75,0** |
| Salt concentration x genotype | 378 | 1914739,0 | 5065,5 | 7,6** |
| Error (b) | 11592 | 7764353,4 | 669,8 | |
| Total | 12191 | 25249673,4 | | |

DF: Dergee of freedom; * and ** significant at 5% and 1%, respectively.

Mean root lengths of the genotypes are given in Table 5. These averages were found 125mm in control plants, 128, 103 and 59 mm respectively increasing salinity. In like manner, Fellahi et al. (2019) showed that 50 mM salinity did not affect the root length in bread wheat varieties grown in differetn salinity concentrations in the petri dishes, however the increase in concentration gradually decreased the root length. The increase of root growth agaist salinity applications was stated by different research teams, too (Ayed et al.,2014; Jbir et al.,2001). In the Table 5, it is clearly shown that the highest root length was detected in Karakılçık (G.N.126) in control, and İskenderiye (G.N.125) in other salinity concentrations. Also the lowest root length was measured in Aydın 93 (G.N.21) in control plants, Meram 2002 (G.N.6) in 100 mM salinity and in Dumlupınar (G.N.7) in other salinity concentrations.

**Table 5** The effects of different salt concentrations on germination rates, coleoptile lengths, shoot sry weights ans root lengths of the 127 durum wheat genotypes

| | Germination rate (%) | | | | Coleoptile length (mm) | | | | Shoot dry weight (mg) | | | | Root length (mm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S.c.(mM) | 0 | 50 | 100 | 200 | 0 | 50 | 100 | 200 | 0 | 50 | 100 | 200 | 0 | 50 | 100 | 200 |
| G.n. | m±std | m±std | m±std | m±std | m±std | m±std | m±std | m±std | m±std | m±std | m±std | m± std | m± std | m±std | m±std | m± std |
| 1 | 87a±5 | 81a±8 | 87a±4 | 74a±10 | 58a±1 | 53a±3 | 40b±4 | 16c±3 | 80a±8 | 83a±5 | 62a±6 | 19b±2 | 106a±30 | 110a±29 | 66b±11 | 28c±7 |
| 2 | 87a±8 | 81a±5 | 61b±6 | 44c±3 | 51a±6 | 45ab±3 | 34b±4 | 11c±3 | 82a±14 | 65a±13 | 42b±1 | 11c±6 | 108a±20 | 69b±24 | 38c±11 | 16d±5 |
| 3 | 83a±7 | 74a±10 | 88a±7 | 89a±4 | 51a±4 | 49a±3 | 36b±3 | 11c±2 | 72a±11 | 73a±9 | 58a±17 | 13b±6 | 86a±21 | 83a±40 | 49b±10 | 19c±4 |
| 4 | 91a±4 | 88a±7 | 89a±4 | 85a±6 | 56a±3 | 51a±7 | 37b±2 | 13c±2 | 75a±16 | 72ab±4 | 52b±11 | 19c±7 | 87a±20 | 70a±12 | 40b±10 | 19c±5 |
| 5 | 94a±5 | 89a±5 | 93a±6 | 85a±6 | 62a±2 | 53a±3 | 41b±3 | 15c±1 | 78a±7 | 79a±16 | 48b±8 | 15c±1 | 117a±26 | 81b±16 | 55c±8 | 21d±4 |
| 6 | 94a±2 | 93a±4 | 91a±5 | 86a±11 | 57a±3 | 49a±2 | 29b±3 | 8c±1 | 62a±9 | 57a±3 | 40a±5 | 2b±0 | 103a±14 | 51b±11 | 29c±6 | 12c±3 |
| 7 | 97a±2 | 96a±3 | 98a±2 | 92a±11 | 49a±4 | 42a±3 | 26b±4 | 4c±2 | 60a±6 | 46ab±5 | 31b±3 | 2c±0 | 72a±13 | 45b±13 | 32b±5 | 11c±5 |
| 8 | 87ab±7 | 89a±6 | 82ab±5 | 72b±12 | 46ab±10 | 53a±6 | 34b±4 | 7c±1 | 55a±9 | 37ab±22 | 26b±6 | 2±0 | 110a±23 | 53b±15 | 37b±6 | 14c±6 |
| 9 | 80a±9 | 81a±5 | 75a±8 | 74a±12 | 53a±2 | 49a±5 | 44a±4 | 23b±2 | 113a±11 | 103a±19 | 92a±4 | 45b±2 | 110a±20 | 119a±32 | 100a±24 | 51b±10 |
| 10 | 65a±11 | 59ab±9 | 57ab±18 | 46ab±25 | 62a±8 | 60a±2 | 48b±6 | 25c±2 | 125a±14 | 108a±2 | 105a±15 | 50b±15 | 138a±34 | 155a±27 | 113b±37 | 59c±12 |
| 11 | 77a±7 | 76a±6 | 82a±4 | 78a±5 | 61a±5 | 54ab±3 | 49b±2 | 26c±5 | 106a±12 | 104a±5 | 93a±10 | 57b±13 | 101a±23 | 138a±29 | 103b±26 | 54c±15 |
| 12 | 79a±10 | 91a±4 | 89a±4 | 84a±6 | 61a±3 | 55ab±3 | 44b±5 | 20c±3 | 107a±19 | 100a±6 | 87a±11 | 45b±4 | 137a±28 | 134a±21 | 105b±16 | 45c±9 |
| 13 | 96a±3 | 90a±7 | 92a±5 | 86a±10 | 60a±4 | 59a±8 | 51a±4 | 25b±5 | 121a±7 | 113a±18 | 78b±45 | 64b±10 | 132a±31 | 113b±26 | 124ab±27 | 57c±11 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **14** | 91a±5 | 85ab±9 | 74b±4 | 77ab±5 | 55a±6 | 52ab±4 | 41b±1 | 19c±8 | 100a±4 | 106a±9 | 90a±10 | 53b±14 | 184a±45 | 187a±24 | 129b±28 | 59c±19 |
| **15** | 87a±9 | 90a±5 | 84a±8 | 92a±5 | 59a±4 | 49a±9 | 49a±3 | 31b±6 | 103ab±10 | 114a±7 | 88b±15 | 61c±10 | 89b±17 | 133a±25 | 89b±20 | 42c±10 |
| **16** | 97a±4 | 90a±5 | 90a±5 | 93a±6 | 56a±8 | 45ab±7 | 43b±4 | 23c±4 | 98a±10 | 103a±10 | 92a±2 | 52b±8 | 78b±14 | 112a±22 | 92b±18 | 44c±10 |
| **17** | 92a±5 | 92a±6 | 90a±11 | 94a±5 | 59a±3 | 51a±4 | 35b±3 | 29b±3 | 81ab±2 | 92a±8 | 90a±10 | 61b±10 | 102c±27 | 150a±23 | 128b±22 | 75d±14 |
| **18** | 81ab±11 | 84ab±3 | 88a±10 | 69b±23 | 49a±12 | 47a±5 | 38a±5 | 20b±2 | 78b±21 | 102a±16 | 72b±21 | 74b±20 | 118a±44 | 134a±27 | 88b±34 | 62c±14 |
| **19** | 95a±5 | 89a±7 | 82a±10 | 85a±6 | 43a±4 | 46a±5 | 38a±7 | 15b±3 | 85a±13 | 100a±4 | 83a±4 | 56b±7 | 97ab±22 | 112a±36 | 90b±24 | 41c±11 |
| **20** | 76a±11 | 61a±12 | 69a±8 | 63a±13 | 44a±6 | 35ab±4 | 31b±3 | 16c±14 | 61a±9 | 60a±7 | 78a±15 | 35b±6 | 87a±18 | 62b±15 | 65b±20 | 30c±6 |
| **21** | 78a±10 | 94a±5 | 89a±4 | 79a±4 | 45a±7 | 42ab±8 | 32b±3 | 18c±1 | 80ab±7 | 92a±12 | 98a±5 | 68b±7 | 72a±11 | 65a±12 | 58a±13 | 35b±6 |
| **22** | 95a±6 | 92ab±7 | 87ab±6 | 78b±8 | 47a±2 | 45a±4 | 38a±3 | 15b±3 | 55a±7 | 61a±9 | 69a±10 | 47a±7 | 93a±15 | 79a±12 | 58b±18 | 38c±6 |
| **23** | 66a±18 | 65a±9 | 65a±14 | 57a±6 | 43a±3 | 37ab±6 | 29b±7 | 16c±4 | 58b±11 | 85a±13 | 41b±14 | 35b±6 | 71a±11 | 72a±20 | 44b±13 | 37b±9 |
| **24** | 66ab±4 | 69a±13 | 64ab±13 | 51b±11 | 41a±6 | 42a±5 | 31a±4 | 11b±2 | 42ab±26 | 59a±10 | 54ab±2 | 34b±16 | 87a±26 | 63b±15 | 46bc±13 | 30c±7 |
| **25** | 88a±0 | 90a±7 | 81a±4 | 78a±10 | 51a±9 | 43a±7 | 40a±5 | 18b±2 | 74ab±13 | 89a±7 | 87ab±13 | 57b±6 | 95a±16 | 80a±18 | 85a±26 | 45b±8 |
| **26** | 79a±5 | 80a±9 | 82a±7 | 71a±11 | 51a±2 | 42ab±7 | 37b±4 | 19c±3 | 67ab±18 | 85a±16 | 83a±34 | 54ab±6 | 97ab±15 | 86ab±19 | 76b±21 | 44c±10 |
| **27** | 81a±11 | 77a±12 | 84a±9 | 70a±7 | 48a±9 | 43a±8 | 29b±5 | 16c±3 | 102ab±12 | 105a±11 | 100a±7 | 57b±19 | 96c±28 | 173a±29 | 131b±18 | 64d±19 |
| **28** | 93a±6 | 79a±9 | 85a±5 | 78a±11 | 57a±3 | 52ab±7 | 41b±2 | 14c±5 | 99a±16 | 105a±10 | 85a±10 | 49b±12 | 107b±18 | 143a±20 | 106b±21 | 64c±13 |
| **29** | 87a±8 | 78a±12 | 87a±7 | 78a±8 | 64a±6 | 61ab±4 | 49b±8 | 19c±2 | 98a±14 | 100a±6 | 94a±6 | 46b±17 | 100b±25 | 129a±28 | 126a±22 | 57c±14 |
| **30** | 78ab±8 | 87a±7 | 70b±24 | 86ab±2 | 57a±1 | 54a±4 | 47a±4 | 20b±5 | 101a±9 | 106a±5 | 95a±10 | 59b±6 | 127b±39 | 180a±27 | 126b±16 | 76c±14 |
| **31** | 86a±5 | 88a±6 | 88a±7 | 77a±4 | 61a±6 | 60a±7 | 46b±3 | 22c±2 | 115a±10 | 115a±13 | 100a±5 | 47b±19 | 104b±24 | 130a±29 | 94b±17 | 47c±9 |
| **32** | 89a±8 | 87a±2 | 75a±17 | 78a±2 | 48a±7 | 35b±5 | 27bc±3 | 23c±3 | 107a±15 | 99a±6 | 72b±19 | 68b±6 | 115a±31 | 129a±19 | 92b±17 | 61c±8 |
| **33** | 87a±4 | 82a±7 | 86a±5 | 85a±8 | 47a±10 | 45a±3 | 30b±6 | 17c±5 | 119a±13 | 111ab±17 | 93b±4 | 62c±9 | 154a±37 | 136ab±28 | 117b±13 | 65c±16 |
| **34** | 94a±7 | 93a±7 | 85a±4 | 82a±5 | 54a±9 | 49a±6 | 37b±7 | 24c±4 | 83ab±14 | 102a±8 | 102a±4 | 67b±13 | 148a±33 | 137a±28 | 95b±26 | 55c±11 |
| **35** | 91a±2 | 91a±5 | 98a±4 | 87a±11 | 58a±5 | 54a±2 | 48a±5 | 26b±6 | 90a±10 | 99a±4 | 93a±10 | 79a±7 | 134a±26 | 126a±20 | 102b±21 | 65c±19 |
| **36** | 79a±5 | 72a±16 | 73a±20 | 69a±7 | 49a±6 | 52a±6 | 44a±2 | 29b±4 | 110a±25 | 118a±24 | 113a±13 | 73b±7 | 105b±23 | 129a±38 | 111ab±24 | 74c±10 |
| **37** | 90a±5 | 94a±5 | 90a±7 | 89a±5 | 55a±7 | 52a±7 | 46a±4 | 33b±3 | 92ab±9 | 107a±7 | 103a±14 | 77b±9 | 128b±33 | 172a±25 | 131c±20 | 78c±12 |
| **38** | 58a±5 | 37b±13 | 66a±2 | 37b±12 | 47a±9 | 47a±7 | 37ab±11 | 31b±5 | 103a±8 | 109a±16 | 78b±22 | 69b±11 | 162a±42 | 152a±31 | 102b±30 | 67c±19 |
| **39** | 84a±9 | 86a±7 | 84a±9 | 79a±9 | 56a±5 | 50a±6 | 44a±4 | 23c±3 | 115a±5 | 117a±10 | 108a±12 | 76b±10 | 141a±36 | 125ab±27 | 116b±23 | 68c±15 |
| **40** | 83a±5 | 87a±7 | 80a±9 | 73a±10 | 54a±5 | 51a±7 | 43ab±6 | 33b±3 | 122a±7 | 110a±9 | 103ab±16 | 85b±17 | 119a±24 | 128a±25 | 110a±23 | 73b±16 |
| **41** | 84a±10 | 79a±12 | 86a±2 | 86a±5 | 55a±6 | 51a±5 | 39b±5 | 31b±3 | 120a±12 | 124a±7 | 104ab±9 | 95b±16 | 139a±36 | 144a±18 | 102b±16 | 53c±9 |
| **42** | 77a±7 | 89a±8 | 88a±5 | 89a±2 | 54a±5 | 51ab±4 | 42b±4 | 26c±7 | 118a±19 | 109a±4 | 107a±5 | 66b±21 | 137a±43 | 147a±21 | 118b±19 | 61c±15 |
| **43** | 86a±11 | 89a±6 | 86a±5 | 73a±9 | 51a±3 | 49ab±9 | 37b±3 | 25c±4 | 94ab±7 | 96ab±12 | 107a±4 | 81b±10 | 167a±39 | 159a±31 | 112b±21 | 62c±16 |
| **44** | 92ab±7 | 90a±4 | 93a±7 | 78a±10 | 53a±7 | 52a±6 | 47a±3 | 31b±3 | 86ab±5 | 95a±9 | 90ab±6 | 72b±7 | 91b±18 | 134a±30 | 118a±24 | 73b±14 |
| **45** | 74a±8 | 70a±15 | 70a±15 | 63a±9 | 40bc±10 | 55a±8 | 45ab±8 | 30c±3 | 104ab±10 | 122a±4 | 109a±4 | 85b±3 | 89c±33 | 131a±32 | 111b±18 | 67d±16 |
| **46** | 82a±8 | 76a±7 | 82ab±7 | 75b±10 | 49a±6 | 40a±7 | 41a±7 | 28b±2 | 96ab±7 | 101a±9 | 90a±10 | 64b±5 | 113b±28 | 101b±39 | 132a±24 | 71c±24 |
| **47** | 88a±0 | 89a±8 | 87a±5 | 83a±7 | 51a±8 | 49a±4 | 41a±3 | 29b±4 | 101a±7 | 110a±15 | 106a±9 | 73b±14 | 147a±31 | 127b±27 | 99c±22 | 62d±15 |
| **48** | 72a±12 | 66a±14 | 69a±2 | 61a±12 | 51a±3 | 53a±5 | 49a±5 | 34a±4 | 92ab±7 | 102a±10 | 95ab±7 | 73b±6 | 145a±35 | 143a±33 | 147a±23 | 96b±17 |
| **49** | 83a±11 | 85a±8 | 87a±8 | 77a±11 | 46a±2 | 43a±7 | 43a±4 | 27bc±4 | 100a±7 | 100a±13 | 98a±5 | 73b±5 | 141a±34 | 154a±26 | 145a±24 | 82b±12 |
| **50** | 88a±10 | 92a±3 | 84a±3 | 85a±6 | 74a±9 | 71a±9 | 58b±7 | 40c±5 | 87ab±7 | 94ab±5 | 96ab±6 | 73b±4 | 110b±20 | 144a±34 | 107b±24 | 77c±16 |
| **51** | 86a±2 | 88a±9 | 84a±7 | 56b±3 | 42a±7 | 36ab±9 | 27bc±7 | 6c±1 | 59a±7 | 42ab±11 | 38a±3 | 2b±0 | 114a±24 | 51b±12 | 35b±4 | 12c±4 |

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| **52** | 83a±6 | 78a±12 | 75a±5 | 87a±9 | 58a±2 | 44b±5 | 41b±3 | 24c±3 | 101a±7 | 108a±14 | 92a±9 | 63b±6 | 87b±20 | 134a±30 | 97b±21 | 56c±14 |
| **53** | 96a±3 | 89a±7 | 86a±7 | 90a±2 | 60a±7 | 56a±5 | 39b±3 | 23c±4 | 100s±8 | 113a±7 | 102a±13 | 69b±9 | 119b±24 | 155a±22 | 119b±20 | 80c±12 |
| **54** | 92a±9 | 86a±8 | 88a±9 | 87a±8 | 57a±4 | 59a±5 | 45b±8 | 23c±5 | 112a±16 | 116a±11 | 99a±7 | 63b±19 | 120b±33 | 150a±25 | 108b±20 | 51c±9 |
| **55** | 82a±12 | 74a±15 | 86a±7 | 86a±12 | 45a±9 | 45a±3 | 37a±3 | 23b±2 | 99a±12 | 102a±5 | 93a±5 | 65b±14 | 146a±36 | 150a±27 | 125b±32 | 89c±12 |
| **56** | 81ab±7 | 87a±7 | 71ab±5 | 68b±10 | 60a±8 | 55a±7 | 52a±6 | 39b±7 | 95a±5 | 90a±18 | 96ab±13 | 78a±5 | 113a±33 | 116a±25 | 120a±26 | 82b±16 |
| **57** | 85a±5 | 80a±6 | 83a±8 | 90a±8 | 62a±8 | 58a±12 | 42b±4 | 32b±12 | 89a±8 | 90a±5 | 81a±8 | 53b±17 | 128a±30 | 126a±28 | 91b±21 | 76b±16 |
| **58** | 81a±8 | 78a±14 | 82a±7 | 73a±12 | 52a±5 | 61a±5 | 52a±11 | 30b±4 | 103a±6 | 106a±6 | 101a±10 | 73b±6 | 137a±32 | 121ab±28 | 106b±24 | 54c±12 |
| **59** | 89a±4 | 94a±2 | 85a±6 | 87a±5 | 55a±5 | 41b±4 | 41b±4 | 33b±6 | 96a±7 | 75a±44 | 90a±21 | 82b±6 | 140a±38 | 125ab±28 | 99b±18 | 72c±12 |
| **60** | 77a±5 | 76a±7 | 76a±7 | 78a±10 | 53ab±8 | 57a±4 | 42bc±6 | 31c±9 | 91ab±22 | 107a±12 | 83b±13 | 69b±17 | 144b±42 | 187a±38 | 115c±41 | 88d±21 |
| **61** | 80a±10 | 76a±6 | 77a±9 | 74a±5 | 50a±8 | 48ab±15 | 42ab±6 | 36b±5 | 105a±6 | 100a±42 | 106a±20 | 91a±6 | 138b±33 | 186a±34 | 122b±23 | 96c±17 |
| **62** | 92a±3 | 86a±8 | 92a±3 | 80a±9 | 62a±6 | 60a±9 | 51a±6 | 24b±5 | 79a±5 | 91a±7 | 76a±7 | 43b±4 | 127a±48 | 113ab±26 | 98b±17 | 49c±16 |
| **63** | 71a±11 | 59ab±9 | 55ab±14 | 44b±13 | 68a±9 | 66a±5 | 59a±7 | 29b±10 | 94a±11 | 93a±12 | 101a±22 | 57b±11 | 103a±22 | 92a±30 | 97a±15 | 45b±14 |
| **64** | 90a±8 | 80a±13 | 81a±8 | 86a±5 | 61a±7 | 62a±5 | 56a±7 | 26b±4 | 90a±9 | 110a±18 | 92a±10 | 66b±11 | 131a±36 | 139a±37 | 125a±22 | 59b±15 |
| **65** | 81a±8 | 52b±16 | 67ab±12 | 68ab±3 | 58ab±6 | 65a±5 | 51b±10 | 28c±4 | 115a±17 | 124a±11 | 106a±21 | 66b±12 | 138a±20 | 130ab±36 | 116b±28 | 64c±12 |
| **66** | 84a±12 | 76ab±10 | 79ab±13 | 66b±15 | 51ab±5 | 62a±6 | 46b±6 | 28c±6 | 89a±4 | 93a±10 | 85a±10 | 60b±12 | 118b±18 | 139a±22 | 126ab±22 | 71c±24 |
| **67** | 75a±10 | 67a±13 | 67a±8 | 74a±14 | 56ab±6 | 68a±4 | 51b±6 | 22c±8 | 94a±2 | 96a±22 | 94a±16 | 53b±19 | 144a±30 | 138a±22 | 128a±24 | 63b±23 |
| **68** | 65a±12 | 58ab±7 | 56ab±10 | 43b±11 | 52a±13 | 56a±12 | 52a±5 | 23b±3 | 102a±9 | 97a±13 | 111a±20 | 57b±8 | 130a±37 | 144a±31 | 126a±26 | 53b±17 |
| **69** | 77ab±4 | 82a±10 | 67ab±8 | 61b±11 | 58a±3 | 58a±3 | 53a±7 | 28b±4 | 102a±14 | 115a±9 | 104a±5 | 66b±3 | 158a±38 | 166a±33 | 132b±32 | 62c±16 |
| **70** | 85a±11 | 81a±11 | 81a±8 | 79ab±12 | 60a±10 | 60a±8 | 49a±9 | 29b±5 | 77a±7 | 88a±9 | 89b±12 | 54b±4 | 152a±23 | 141a±28 | 114b±24 | 59c±11 |

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| **71** | 75a±13 | 66ab±15 | 62ab±10 | 57b±12 | 65a±10 | 62a±10 | 49b±12 | 29c±9 | 96a±15 | 107a±8 | 97a±13 | 60b±20 | 165a±25 | 148a±35 | 128b±27 | 53c±18 |
| **72** | 85a±6 | 79a±7 | 74a±10 | 72a±10 | 66a±6 | 68a±7 | 45b±21 | 24c±8 | 97b±6 | 121a±10 | 102ab±13 | 54c±2 | 177a±26 | 167a±25 | 128b±25 | 54c±10 |
| **73** | 90a±5 | 92a±3 | 90a±4 | 84a±7 | 66a±6 | 60a±3 | 45b±10 | 36b±6 | 87ab±5 | 102a±5 | 90ab±11 | 73b±15 | 183a±37 | 149b±39 | 125c±29 | 87d±32 |
| **74** | 91a±6 | 84ab±13 | 70b±10 | 78ab±11 | 61a±5 | 57a±6 | 55a±7 | 30b±5 | 79ab±7 | 89a±7 | ab±11 | 65b±9 | 128a±38 | 129a±34 | 128a±25 | 69b±13 |
| **75** | 79a±13 | 82a±8 | 82a±4 | 76a±17 | 55ab±13 | 59a±6 | 47bc±12 | 36c±7 | 89a±6 | 70ab±40 | 76ab±9 | 61b±22 | 99b±50 | 130a±33 | 93bc±38 | 77c±23 |
| **76** | 83a±5 | 85a±11 | 83a±11 | 66b±8 | 65a±10 | 62a±5 | 50a±9 | 36b±8 | 77a±5 | 82a±21 | 80a±13 | 67ab±8 | 125a±36 | 132a±35 | 123a±28 | 81b±18 |
| **77** | 81a±11 | 82a±15 | 83a±5 | 64a±8 | 56a±10 | 54a±3 | 40b±6 | 29b±5 | 80ab±10 | 58b±31 | 83a±6 | 68ab±6 | 116b±31 | 137a±20 | 126ab±33 | 72c±18 |
| **78** | 91a±4 | 77a±5 | 79a±9 | 80a±6 | 61a±4 | 61a±7 | 48b±6 | 26c±4 | 75a±10 | 81a±7 | 71a±7 | 64a±5 | 162a±44 | 150a±31 | 121a±27 | 51b±19 |
| **79** | 88a±3 | 74ab±19 | 69bc±7 | 56c±13 | 52a±7 | 52a±9 | 42ab±3 | 26b±2 | 103b±18 | 128a±12 | 101b±7 | 74c±17 | 102a±28 | 124a±23 | 109b±22 | 54c±15 |
| **80** | 78a±17 | 73a±11 | 63a±12 | 73a±14 | 48b±12 | 63a±7 | 49b±6 | 28c±7 | 106a±11 | 110a±12 | 92ab±16 | 72b±17 | 114a±41 | 139a±34 | 113b±26 | 71c±25 |
| **81** | 68ab±18 | 83a±4 | 68ab±13 | 64b±27 | 56a±4 | 58a±3 | 47a±6 | 30b±4 | 92a±17 | 87a±5 | 90a±12 | 75a±13 | 135a±49 | 158a±38 | 126b±35 | 82c±22 |
| **82** | 79a±11 | 78a±7 | 77a±14 | 52b±28 | 52a±5 | 48ab±5 | 31b±5 | 21b±3 | 85a±7 | 97a±24 | 83a±6 | 56b±3 | 156a±44 | 160a±25 | 116b±30 | 64c±18 |
| **83** | 82a±8 | 77a±9 | 73a±19 | 83a±4 | 51a±6 | 54a±6 | 39b±7 | 22c±5 | 90ab±10 | 108a±7 | 85b±10 | 68b±10 | 135ab±42 | 143a±27 | 120b±25 | 65c±17 |
| **84** | 67a±12 | 80a±5 | 69a±4 | 77a±5 | 75a±11 | 85a±8 | 54b±14 | 33c±11 | 85ab±11 | 70bc±40 | 93a±5 | 61c±18 | 107a±37 | 117a±37 | 75b±28 | 48c±25 |
| **85** | 87a±9 | 95a±2 | 88a±7 | 87a±6 | 78a±9 | 66a±14 | 62a±5 | 38c±6 | 78ab±8 | 92a±8 | 101a±9 | 70b±6 | 112ab±25 | 123a±29 | 96b±29 | 58c±15 |
| **86** | 86ab±8 | 92a±3 | 81ab±8 | 71b±5 | 84a±11 | 83a±15 | 57b±11 | 41c±3 | 83ab±4 | 91a±6 | 87a±9 | 64b±13 | 128a±33 | 116a±29 | 80b±23 | 52c±20 |
| **87** | 75a±8 | 72a±7 | 71a±12 | 61a±11 | 72a±8 | 79a±8 | 60b±14 | 29c±8 | 82ab±16 | 76ab±12 | 71ab±12 | 57b±11 | 133a±30 | 110b±31 | 76c±28 | 37d±12 |
| **88** | 86a±7 | 79a±13 | 78a±7 | 72a±12 | 70a±10 | 57b±14 | 52b±18 | 29c±5 | 83a±4 | 86a±13 | 93a±9 | 50b±31 | 131a±43 | 127a±41 | 100b±28 | 60c±21 |
| **89** | 76a±9 | 75a±8 | 74a±5 | 68a±11 | 75a±8 | 65ab±19 | 56b±8 | 32c±2 | 93a±9 | 98a±6 | 96a±11 | 81a±3 | 144a±28 | 125ab±26 | 111b±21 | 59c±11 |

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| **90** | 86a±10 | 84ab±3 | 75ab±4 | 69bc±4 | 71a±8 | 67a±5 | 53b±10 | 35c±8 | 85a±7 | 91a±17 | 81ab±11 | 60b±13 | 113a±24 | 126a±29 | 89b±28 | 61c±13 |
| **91** | 81a±4 | 86a±5 | 86a±5 | 79a±9 | 77a±7 | 67ab±18 | 63b±4 | 26c±7 | 99a±3 | 91a±42 | 93a±10 | 65b±6 | 136a±20 | 116b±27 | 72c±19 | 42d±13 |
| **92** | 74a±12 | 69a±20 | 80a±11 | 72a±6 | 60a±8 | 54ab±9 | 43b±12 | 18c±5 | 91ab±6 | 110a±13 | 87b±12 | 39c±8 | 89b±25 | 112a±29 | 79b±18 | 33c±10 |
| **93** | 66a±10 | 72a±12 | 66a±7 | 62ab±5 | 67a±6 | 69a±12 | 60a±6 | 25b±10 | 121a±9 | 125a±11 | 105a±7 | 67b±27 | 117a±30 | 118a±28 | 93b±24 | 45c±16 |
| **94** | 90a±10 | 91a±2 | 84a±6 | 79a±11 | 73ab±7 | 76a±8 | 64b±6 | 38c±6 | 81a±8 | 79a±8 | 85a±5 | 70a±17 | 134a±50 | 130a±21 | 125a±24 | 73b±24 |
| **95** | 81a±13 | 77a±6 | 77a±6 | 68a±5 | 87a±15 | 73b±15 | 61c±19 | 36d±7 | 87a±3 | 77a±2 | 70a±4 | 70a±8 | 90b±31 | 127a±26 | 80b±23 | 56c±20 |
| **96** | 72a±14 | 76a±7 | 70a±4 | 68a±5 | 82a±6 | 73a±11 | 55b±6 | 26c±2 | 119a±14 | 106a±10 | 107a±13 | 77b±13 | 120a±23 | 132a±19 | 116a±23 | 62b±14 |
| **97** | 77a±9 | 77a±5 | 72a±10 | 75a±8 | 66a±8 | 59ab±18 | 54b±4 | 33c±4 | 93a±19 | 103a±15 | 88ab±5 | 68b±9 | 127a±34 | 116a±25 | 94b±20 | 62c±13 |
| **98** | 72a±12 | 72a±8 | 76a±10 | 62a±12 | 87a±13 | 78a±5 | 62b±13 | 36c±10 | 80a±8 | 86a±8 | 82ab±16 | 65a±5 | 126a±32 | 115ab±28 | 96b±21 | 65c±22 |
| **99** | 84a±10 | 89a±4 | 79a±5 | 80a±10 | 64a±9 | 65a±6 | 75a±19 | 30b±6 | 75a±10 | 76ab±7 | 84a±4 | 63a±10 | 113a±30 | 115a±21 | 88b±30 | 53c±21 |
| **100** | 93a±7 | 84ab±17 | 89ab±8 | 75b±4 | 81a±11 | 65b±9 | 68b±7 | 21c±5 | 73ab±22 | 83a±14 | 80a±1 | 54b±14 | 92ab±32 | 104a±24 | 82b±21 | 35c±13 |
| **101** | 64b±9 | 89a±8 | 75ab±9 | 68b±10 | 81a±8 | 67b±10 | 54c±3 | 21d±3 | 85a±17 | 86a±33 | 72ab±10 | 54b±4 | 93a±23 | 99a±34 | 61b±32 | 35c±20 |
| **102** | 83a±4 | 86a±8 | 85a±7 | 86a±7 | 88a±7 | 66b±18 | 59b±8 | 28c±3 | 74ab±9 | 69ab±5 | 75a±7 | 52b±4 | 110a±36 | 109a±33 | 102a±27 | 51b±18 |
| **103** | 87a±2 | 85a±9 | 78a±10 | 77a±11 | 80a±11 | 73a±5 | 58b±10 | 24c±3 | 59a±3 | 62a±18 | 54a±14 | 43a±9 | 97a±29 | 110a±29 | 68b±23 | 42c±21 |
| **104** | 91a±8 | 90a±8 | 87ab±4 | 72b±22 | 94ab±11 | 79a±10 | 66b±11 | 34c±8 | 79a±14 | 93a±9 | 79a±24 | 49b±13 | 114a±35 | 119a±17 | 77b±31 | 39c±21 |
| **105** | 93a±7 | 91a±4 | 95a±5 | 89a±2 | 53a±12 | 56a±4 | 48a±9 | 35b±4 | 81ab±30 | 97a±7 | 87a±5 | 63b±12 | 109b±46 | 137a±28 | 105b±18 | 44c±12 |
| **106** | 92a±9 | 90a±5 | 90a±7 | 89a±2 | 60a±14 | 54ab±9 | 48b±5 | 29c±4 | 102a±16 | 121a±31 | 110a±12 | 66b±18 | 146a±27 | 146a±23 | 105b±18 | 54c±15 |
| **107** | 88a±9 | 88a±0 | 91a±7 | 88a±3 | 58ab±12 | 67a±6 | 48b±6 | 29c±7 | 86a±5 | 84a±10 | 79a±8 | 50b±7 | 111a±19 | 93a±24 | 95a±21 | 31b±11 |
| **108** | 93a±7 | 91a±8 | 87a±4 | 82a±11 | 64a±8 | 56a±14 | 57a±7 | 30b±5 | 79a±12 | 88a±11 | 87a±20 | 51b±11 | 138a±26 | 108b±25 | 92b±27 | 40c±21 |
| **109** | 93a±2 | 89a±5 | 92a±6 | 85a±2 | 58a±10 | 66a±5 | 42b±9 | 29c±6 | 106a±10 | 109a±9 | 97a±7 | 69b±15 | 121a±27 | 118a±22 | 102a±23 | 56b±16 |
| **110** | 81a±10 | 82a±8 | 82a±11 | 69a±4 | 63a±9 | 49b±13 | 48b±10 | 28c±3 | 102a±9 | 103a±13 | 97a±7 | 88b±3 | 138a±32 | 126ab±43 | 115b±22 | 52c±18 |
| **111** | 71a±8 | 70a±14 | 78a±10 | 63a±6 | 62a±3 | 58ab±12 | 50bc±5 | 39c±29 | 102a±7 | 97a±3 | 94a±11 | 68b±22 | 137a±25 | 115b±35 | 106b±18 | 50c±19 |
| **112** | 94a±10 | 83a±16 | 89a±8 | 82a±10 | 62a±7 | 54ab±7 | 48b±5 | 30c±2 | 109a±11 | 105a±11 | 100a±11 | 73b±8 | 148a±34 | 116b±33 | 117b±16 | 70c±17 |
| **113** | 84a±3 | 82a±11 | 80a±6 | 63b±20 | 65a±4 | 65a±5 | 54a±3 | 40b±5 | 103a±9 | 94ab±14 | 104a±11 | 73b±6 | 136ab±23 | 152a±34 | 127b±41 | 67c±19 |
| **114** | 66a±11 | 54a±14 | 60a±19 | 52a±6 | 46ab±6 | 51a±6 | 37bc±10 | 26c±5 | 117a±8 | 118a±10 | 88b±18 | 62c±10 | 139a±31 | 130a±30 | 137a±39 | 87b±13 |
| **115** | 84a±10 | 84a±13 | 90a±2 | 75a±17 | 56a±10 | 64a±7 | 56a±4 | 42b±4 | 89a±5 | 85a±13 | 84a±9 | 75a±3 | 166a±46 | 141b±34 | 110c±19 | 55d±15 |
| **116** | 77a±12 | 56b±19 | 85a±7 | 59b±2 | 49a±6 | 43ab±5 | 36bc±6 | 29c±4 | 106a±2 | 103a±14 | 96a±13 | 69b±12 | 157a±33 | 145a±33 | 111b±17 | 67c±17 |
| **117** | 84a±9 | 81a±11 | 72a±10 | 77a±13 | 67a±4 | 50b±3 | 48b±6 | 26c±3 | 105a±10 | 112a±6 | 113a±10 | 78b±15 | 144ab±33 | 159a±35 | 139b±36 | 95c±23 |
| **118** | 93a±6 | 90a±10 | 85a±11 | 79a±11 | 57a±6 | 47ab±8 | 36b±4 | 22c±4 | 86a±9 | 83a±9 | 94a±6 | 54b±8 | 115b±36 | 154a±42 | 145a±22 | 87c±23 |
| **119** | 89a±7 | 92a±3 | 95a±8 | 95a±5 | 56a±4 | 51ab±6 | 40b±5 | 22c±2 | 88a±3 | 83a±5 | 83a±11 | 66a±4 | 156a±48 | 156a±34 | 125b±25 | 81c±18 |
| **120** | 93a±8 | 91a±4 | 82a±8 | 84a±6 | 52a±6 | 45a±3 | 34b±6 | 23b±1 | 84a±7 | 87a±3 | 83a±10 | 53b±6 | 149a±49 | 151a±27 | 123b±37 | 88c±21 |
| **121** | 83a±8 | 80a±3 | 62b±2 | 68ab±17 | 54a±7 | 43ab±5 | 40b±3 | 21c±3 | 76ab±6 | 91a±10 | 92a±3 | 65b±8 | 168a±30 | 139b±36 | 132b±25 | 75c±19 |
| **122** | 89a±6 | 90a±5 | 86a±7 | 87a±14 | 46a±13 | 38a±10 | 39a±5 | 18b±4 | 100a±16 | 97a±10 | 97a±7 | 80a±11 | 171a±32 | 157a±40 | 144b±26 | 93c±15 |
| **123** | 81ab±9 | 86a±10 | 72ab±15 | 65b±4 | 46a±10 | 41a±6 | 39a±14 | 23b±3 | 106a±13 | 100a±10 | 94a±9 | 59b±9 | 175a±44 | 152b±41 | 136b±29 | 90c±22 |
| **124** | 93a±7 | 87ab±6 | 89ab±4 | 74b±10 | 57a±2 | 46a±11 | 31b±5 | 23b±5 | 85ab±11 | 95a±6 | 96a±10 | 71b±14 | 184a±45 | 183a±30 | 133b±28 | 100c±26 |
| **125** | 92a±9 | 95a±5 | 94a±2 | 81a±5 | 51a±12 | 40ab±8 | 32bc±7 | 21c±3 | 104a±19 | 102a±19 | 102a±20 | 73b±5 | 133c±68 | 193a±37 | 157b±27 | 110d±19 |
| **126** | 91a±5 | 95a±5 | 93a±9 | 95a±6 | 75a±8 | 57b±5 | 49bc±11 | 37c±3 | 68ab±13 | 79ab±7 | 90a±7 | 59b3 | 189a±30 | 162b±31 | 126c±27 | 97d±21 |
| **127** | 94ab±8 | 95a±6 | 78b±2 | 89ab±7 | 81a±9 | 68b±8 | 53c±7 | 37d±3 | 92a±6 | 97a±10 | 106a±5 | 67b9 | 102b±28 | 125a±34 | 103b±25 | 72c±15 |
| **WG** | 83,6±11 | 81,7±13 | 80,2±12 | 75±15 | 59±13 | 55±13 | 45±12 | 26±9 | 91±19 | 95±22 | 87±20 | 60±21 | 378±113 | 466±154 | 386±146 | 216±94 |

S.c.:Salt concentration, G.n.:Genotype number, S.d.:Standart deviation;means with the same letter in the columns do not differ significantly ($p<0.01$)

Similarly other three paremeters, four group have had similar averages as shown in Figure 4. According to table, gene bank genotypes affected more than others with 55% in the highest salinity.

### 3.1. General effect of salinity on durum wheat genotypes

The results showed that the most tolerant cultivars were found as C9 (G. N. 61, foreign), Akçakale-2000 (G. N. 37; Turkish) and Vatan (G.N.50; Turkish) genotypes and the most sensitive ones were found Zenit (G.N.51;foreign), Çeşit-1252 (G.N.2;Turkish) and Şölen-2002 (G.N.8;Turkish) respectively, at the highest salt concentration (200 mM NaCl). Being certificed of these tolerant genotypes as 'cultivar', may be associated of having

stress tolarance mechanisms through the breeding period. Akçakale 2000 and Vatan genotypes were also declared as having high pasta quality with their high sedimentation values (Koyuncu, 2009). In addition to these, Ay et al. (2011) declared that Şölen 2002, which is the most sensitive genotypes of the present study, was found sensitive against yellow rust and brown rust in two different researches. Another sensitive genotype, Çeşit 1252 was notified as having low pasta cooking quality and that situation was correalated with its protein quality and quantity (Bozkurt, 2012). The negative findings of these genotypes may be a response of their sensitivity against salinity.

## 4. Conclusions

Germinaion stage is an important period of plant growth. At the beginning of the study two things were aimed: to learn the effects of salinity on durum wheat genotypes' at germination stage and to select sensetive and tolerant genotypes of them. Firstly, mean comparision signed that salinty affected germination rate, coleoptile length, shoot dry weight and root length of the 127 durum wheat genotypes' negatively at germination stage. Secondly C9 (G.N.61,foreign), Akçakale-2000 (G.N.37;Turkish) and Vatan (G.N.50; Turkish) genotypes were found the most tolerant genotypes, while Zenit (G.N.51;foreign), Çeşit-1252 (G.N.2;Turkish) ve Şölen-2002 (G.N.8;Turkish) genotypes were detected as the most sensitive in 200 mM salt concentration (the highest concentration of the presens study). It is suggested that the producers should prefer these tolerant genotypes and avoid sensetive ones in the salty soils. It is necessary conducting new treatments with longer periodand making detailed analysies for more precise results. The tolerance mechanisms of the tolerant genotypes may been discoursed by breeders to develop new tolerant cultivars.

## Declaration of Author Contributions

The authors declare that they have contributed equally to the article. All authors declare that they have seen/read and approved the final version of the article ready for publication.

## Declaration of Conflicts of Interest

All authors declare that there is no conflict of interest related to this article.

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