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Response of Some Rice Varieties (*Oryza sativa L.*) to Salinity

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ABSTRACT

In our country, soil salinity is an extremely important problem. In particular, it occurs in regions where poor drainage conditions. It leads to significant yield and quality losses in products. Selection of tolerant plants to salinity is essential in terms of soil improvement and product yield. Paddy plants are resistant to salinity to a certain degree and can be used in the improvement of salty soils. However, the salinity resistance of each paddy type may vary. In this research, the response of seeds was measured in saline concentrations of 14 rice cultivars at different doses (0 ppm, 500 ppm, 1400 ppm, 1800 ppm, 3600 ppm, 5200 ppm). To applications; germination percentage, grass scabbard length, etc. were investigated. It was determined that germination decreased from 97.46% to 95.48% and the grass scabbard length decreased from 2.4781 to 1.9271 with increasing salt doses. Among the varieties, it has been determined that Kızıltan stands out in the germination rate, Meco and Vasco in the grass scabbard length. All varieties were taken to study as 3 repetitions. In terms of germination percentage and length of grass scabbard among the varieties studied, statistical data were; 1% and 5% were found to be important.

In this study, the performance of the varieties against salinity was determined and it was determined that some varieties could be used for resistance to salinity.

Keywords: Doses, Rice, Salinity, Variety.

Bazı Çeltik Çeşitlerinin (*Oryza sativa L.*) Tuzluluğa Tepkisi

ÖZ

Ülkemizde, toprak tuzluluğu çok önemli bir problemdir. Özellikle, zayıf drenaj koşullarındaki bölgelerde ortaya çıkmaktadır. Tuzluluk, üretimde önemli verim ve kalite kayıpları ortaya çıkarır. Çeltik bitkisinin belli dereceye kadar tuzluluğa dayanıklı olduğu ve tuzlu toprakların ıslahında kullanılabilmektedir. Fakat her çeltik çeşidinin tuzluluğa dayanıklılığı değişkenlik gösterebilir. Araştırmamızda, 14 çeltik çeşidi tohumlarının farklı dozlarda (0 ppm, 500 ppm, 1400 ppm, 1800 ppm, 3600 ppm, 5200 ppm) tuz konsantrasyonlarında ölçülmüştür. Çalışmalarda; çimlenme yüzdesi ve çim kını uzunluğu belirlenmiştir. Artan tuz dozlarıyla çimlenmenin %97.46'dan %95.48'e gerilediği ve çim kını uzunluğununsa 2.4781'den 1.9271'e gerilediği saptanmıştır. Çeşitlerden, çimlenme oranında Kızıltan'ın, çim kını uzunluğunda Meco ve Vasco'nun diğerlerine göre öne çıktığı belirlenmiştir. Çimlenme yüzdesi ve çim kını uzunluğu bakımından çeşitler arasında %1 ve %5 önemli bulunmuştur.

Bu çalışmada, tuzluluğa karşı çeşitlerin performansı belirlenmiş ve bazı çeşitlerin tuzluluğa karşı dirençli olduğu saptanmıştır.

Anahtar Kelimeler: Dozlar, Çeltik, Tuzluluk, Çeşit.

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1. Introduction

Salinity is an important problem despite all the technological advances going forward. Various physiological parameters are negatively affected during growth and development of plants exposed to salinity during their cultivation. In addition, it the biochemical changes possibly occurring when plants are subjected to harmful stress conditions. It is a fundamental question that is seen in very wide areas of the world [1].

The rice is the third in terms of yields and production in the world, with a total area of 159.8 million hectares and a production quantity of 741.0 million tons from other cereal crops [2]. A significant portion (over 90%) of rice production in the world is carried out in Asian countries [3]. The countries with the most rice production are respectively; China (209.5 million tons), India (158.8 million tons) and Indonesia (77.3 million tons). India is the first country with 43.0 million hectares in terms of planting area. However, production problems to marginal areas like to areas in high slopes with irrigation not suitable for rice cultivation, inadequate maintenance because of the reasons for the amount of production is in the second sequence [4].

Turkey ranks 37 in the world by production quantities of 900 thousand tons of rice, ranks 5th with high yields obtained from unit area. The development of high-yielding varieties and their use in production in Turkey increases the amount of production. Rice production in our country is carried out at about 110 thousand hectares, yield 821 kg da^{-1} [5]. The rice is originated in Southeast Asia, spreading from South India to China about 6000 years ago and reaching about 500 years ago in Turkey [6]. The rice produced is the *Oryza* species that easily adapt to different habitats [7]. It can easily adapt to different textures (sandy-loam, clay) and pH 3-8 soil. Rice crop is moderately resistant to salinity, all stages of development is important for the determination of the salinity damage. In highly salty soils; germination, tillering and plant height becomes a decrease [8].

In different regions of the world; There are different production systems such as Upland rice, Aerobic Rice, Irrigated lowland, Rainfed lowland, Deep water and Floating rice production, and the production system made by irrigation is the most preferred system by the producers [9].

In studies conducted throughout the all vegetation period in different types of rices such as Indica and Japonica, researchers have determined that some varieties are tolerant to salinity [10, 11]. In studies conducted during the germination stage of seedlings, researchers have reported that some rice genotypes are medium tolerance and tolerant to salinity [12, 13].

The yield and quality loss is high in salty soils where rice cultivation is made [8]. The amount requested by consumers to increase the production of rice products in Turkey and to provide at a reasonable price is of great importance. To increase the amount of production; It is extremely important to identify rice genotypes that meet regional environmental conditions per unit area and have high yield and quality parameters. The yield and yield components in the crop are affected significantly in the region where it is cultivated [14]. Genetic structure, environment, and genotype x environment interactions are important factors affecting the performance of genotypes [15]. Selection of rice varieties suitable for the production of rice; it will benefit the producer in terms of high efficiency, and the consumer in terms of quality. With this research, the response of some rice varieties due to the salt concentration was investigated. It is known that the production amount and yield values are low in soils with high salt content where paddy cultivation is done.

According to the results, it is aimed to increase the production amount and yield by determining the varieties resistant to salinity and recommending them to the growers in regions with high salinity.

2. Methodology

In the study was used 14 rice (*Oryza sativa L.*) varieties. Varieties; Trakya Agricultural Research Institute (9 varieties), Harman Seed Food Marketing Agricultural Trade (2 varieties), Tekcan Seed Food and Agricultural Products Industry (3 varieties) were obtained (Table 1). The obtained to seed samples were counted 100 units and placed in Petri dishes. All varieties included in this study as three replications. All varieties of seeds at 6 different doses (0 ppm, 500 ppm, 1400 ppm, 1800 ppm, 3600 ppm, 5200 ppm) in 90% NaCl solution was added. Doses applied to the samples were prepared with 100 ml of distilled water. The 90% NaCl solution was given to the rice seeds at room temperature and was applied 6 times a day. A 0.01 mm precision caliper was used to determine the length of grass scabbard. The obtained results were analyzed by SPSS 17.0 statistics program. Duncan multiple comparison test was applied in the analysis. Tests were carried out at 1% and 5% levels.

Table 1. *Varieties used in the research and the institutions from which they were provided.*

Varieties	Provided Organizations
Halilbey	Trakya Agricultural Research Institute
Osmancık-97	Trakya Agricultural Research Institute
Şumnu	Trakya Agricultural Research Institute
Edirne	Trakya Agricultural Research Institute
Çakmak	Trakya Agricultural Research Institute
Kızıltan	Trakya Agricultural Research Institute
Efe	Trakya Agricultural Research Institute
Mis 2013	Trakya Agricultural Research Institute
Tosyagüneşi	Trakya Agricultural Research Institute
Cammeo	Harman Seed Food Marketing Agricultural Trade
Meco	Harman Seed Food Marketing Agricultural Trade
Ronaldo	Tekcan Seed Food and Agricultural Products Industry
Nembo	Tekcan Seed Food and Agricultural Products Industry
Vasco	Tekcan Seed Food and Agricultural Products Industry

3. Results and Discussion

Different rice genotypes (*Oryza sativa L.*) generally become very sensitive at the seedling period, affecting plant density in salt-affected fields [16, 17]. As a percentage of germination in the study, the difference between the varieties at all doses of NaCl was statistically significant at 1% and 5% levels. The average germination percentages of the varieties were determined to be 97.46% (0 ppm) without NaCl application (Table 2). In other studies on salinity, the difference between rice genotypes was found statistically significant [18]. When the highest control germination percentage is obtained in the Nembo variety, the Efe and Meco varieties has the lowest germination percentage. The average of the varieties of NaCl-500 ppm application decreased to 97.14%. Meco has the lowest germination percentage while Kızıltan variety has the highest germination percentage. Tosyagüneşi and Ronaldo varieties came to the foreground in NaCl-1400 ppm dose application. The germination percentages of the varieties with the NaCl-1800 ppm varieties mean dose are 96.42% and the Nembo variety have the minimum germination percentages. In the tested varieties, there was a severe change in NaCl-3600 ppm and NaCl-5200 ppm doses and a significant decrease in the average of the varieties. Especially, Mis 2013 and Halilbey varieties with the NaCl-5200 ppm dose gave the lowest germination percentage value with the lowest 94.30% and 94.33%, respectively. The researchers obtained similar results in different studies [19, 20, 21]. In addition, the root dry weight, the length of the grass scabbard are important parameters in determining the salinity [11]. It was determined that the difference between the varieties in terms of grass lengths of some rice cultivars subjected to NaCl application at different doses was statistically significant at 1% level at all doses (Table 3).

Table 2. *Effect of NaCl application at different doses on germination percentage in some rice varieties*

Varieties/Doses	Germination Percentage (%)					
	0 ppm	500 ppm	1400 ppm	1800 ppm	3600 ppm	5200 ppm
Halilbey	97.91 ab**	97.13 ab*	96.38 bc*	96.13 ab*	95.65 bc*	94.33 b*
Osmancık-97	98.30 ab	97.31 ab	96.82 ab	95.71 b	96.11 abc	96.51 ab
Şumnu	96.97 ab	97.47 ab	96.99 ab	96.52 ab	95.71 bc	96.00 ab
Edirne	97.30 ab	97.80 ab	96.05 c	96.44 ab	95.32 c	95.00 ab
Çakmak	96.94 ab	96.13 ab	97.07 ab	95.67 b	96.65 abc	95.67 ab
Kızıltan	97.81 ab	98.80 a	96.71 b	96.00 ab	97.58 a	97.00 a
Efe	96.30 b	97.52 ab	97.38 ab	97.00 ab	96.32 abc	96.00 ab
Mis 2013	97.63 ab	97.13 ab	96.66 b	96.19 ab	95.39 c	94.30 b
Tosyagüneşi	96.88 ab	96.47 ab	97.68 a	96.67 ab	95.74 bc	95.00 ab
Cammeo	97.41 ab	98.45 ab	97.38 ab	97.72 a	96.26 abc	95.67 ab
Meco	96.30 b	95.80 b	96.61 b	96.67 ab	96.18 abc	94.62 b
Ronaldo	97.73 ab	96.94 ab	97.71 a	97.00 ab	96.09 abc	95.71 ab
Nembo	98.94 a	98.13 ab	96.91 b	95.53 b	97.37 ab	96.33 ab
Vasco	97.78 ab	96.80 ab	96.59 b	96.61 ab	96.03 abc	95.00 ab
Mean	97.46a*	97.14ab	96.92ab	96.42ab	96.17b	95.48b
C.V	1.0	1.1	0.8	0.9	0.7	1.2

*,**; It is important at 5%, 1%, respectively

Table 3. *Effect of NaCl application at different doses on length of grass scabbard in some rice varieties*

Varieties/Doses	Length of Grass Scabbard (mm)					
	0 ppm	500 ppm	1400 ppm	1800 ppm	3600 ppm	5200 ppm
Halilbey	2.1510 e**	2.1603 de**	2.0753 d**	2.0630 d**	1.9050 d**	1.6260 d**
Osmancık-97	2.4747 a-e	2.4203 a-d	2.3420 a-d	2.3143 bcd	2.2000 a-d	1.9210 a-d
Şumnu	2.2190 de	2.1183 de	2.0880 d	2.2577 cd	1.9453 d	1.6663 d
Edirne	2.2613 de	2.0500 e	2.1303 d	2.1453 d	2.0997 cd	1.7083 d
Çakmak	2.6813 abc	2.5803 abc	2.5503 abc	2.5653 abc	2.4073 abc	2.1283 abc
Kızıltan	1.6970 f	1.5960 f	1.5660 e	1.5810 e	1.4230 e	1.1440 e
Efe	2.4303 b-e	2.3293 b-e	2.2993 bcd	2.3580 a-d	2.1563 bcd	1.8773 bcd
Mis 2013	2.3737 cde	2.2727 cde	2.2427 cd	2.1033 d	1.9873 d	1.8207 cd
Tosyagüneşi	2.7340 ab	2.6330 ab	2.6030 ab	2.6180 ab	2.4600 ab	2.1810 ab
Cammeo	2.7357 ab	2.7003 a	2.6047 ab	2.6197 ab	2.5273 a	2.1827 ab
Meco	2.8050 a	2.7040 a	2.6740 a	2.6890 a	2.5310 a	2.2520 a
Ronaldo	2.8013 a	2.6347 ab	2.6703 a	2.6853 a	2.4617 ab	2.2483 a
Nembo	2.5213 a-d	2.3737 a-e	2.3903 a-d	2.4053 a-d	2.2473 a-d	1.9683 a-d
Vasco	2.8077 a	2.7067 a	2.6767 a	2.6917 a	2.5337 a	2.2547 a
Mean	2.4781a**	2.3771b	2.3509b	2.3641b	2.2061c	1.9271d
C.V	8.5	9.0	9.4	9.7	10.3	11.6

*,**; It is important at 5%, 1%, respectively

In the case of NaCl-5200 ppm dozen application, there was a significant decrease compared to other doses. While Ronaldo, Meco and Vasco varieties have the highest grass scabbard length, Kızıltan variety has the lowest value [21, 22]. According to the research results, it was determined that Vasco, Nembo, Ronaldo, Meco, Cammeo, Tosyagüneşi, Çakmak, Osmancık-97 genotypes were more resistant to salinity than other genotypes that can be used in soils with high salt content where paddy is grown.

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