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Research Article

The Effects of Salinity on Germination and Seedling Growth of Some Canola Varieties

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ABSTRACT

The present thesis focused on determination of the effect of salinity on germination and seedling growth of some canola varieties. Factorial experiments were conducted in randomized complete block design with replications including 4 canola cultivars (PR44W29, NK LINUS, DK EXTORM, ES NEPTUNE) and 6 salinity levels (0, 5, 10, 15, 20, 25% Electrical connectivity (EC) generated through addition of 0, 2.75, 5.72, 9, 12.45 and 15.70 g/l NaCl, respectively). Following 7 day germination tests, number of germinated seeds were counted and length of whole plant, shoot and root fresh and dry weights were measured.

The highest germination rate (85.5%) was obtained from 0% EC salinity level of DK EXTORM and the lowest (1.5%) from 25% EC level of NK LINUS variety. The differences in germination rates of the experimental groups were not found to be significant (P>0.05). The highest seedling height (74 mm) was obtained from 5% EC level of NK LINUS variety and the lowest from 25% EC level of PR44W29 and DK EXTORM varieties (P<0.05). The highest root length (64.1 mm) was observed in 5% EC level of NK LINUS variety. However, because of high salinity levels, ES Neptune and DK EXTORM and PR44W29 varieties did not achieve root development at 25% EC salinity level (P<0.05). The highest fresh weight (125.9 g) was obtained from 5% EC level of NK LINUS variety and the lowest (0 g, all seedlings were dead) from 25% EC level of ES NEPTUNE and DK EXTORM varieties (P<0.05). The highest dry weight (5.5 g) was obtained from 20% EC level of NK LINUS variety. Dry weights were not able to be measured in ES Neptune and DK EXTORM varieties since seeds died at high level salinity levels. The lowest dry weights (2.1 and 2.7 g) were obtained from 25% EC level of DK EXTORM and PR44W29 varieties, respectively. In general, decreasing germination, seedling length, fresh and dry weights were observed with increasing salinity levels (from 0% EC to 25% EC).

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1. INTRODUCTION

A relatively new crop and the only one that was "made in Canada", canola has become one of the world's most important oilseed crops and profitable choice for Canadian farmers in only a few decades.

Canola is a type of edible rapeseed. Canola is not individual species. It has breaded from 3 rapeseed species. İt has genetically low in erucic acid and glucosinolates. Canola differs from standard or

industrial rapeseed since it has less than 2 percent erucic acid in the oil and less than 30 micromoles glucosinolate per gram of the meal. These two quality standards allow canola oil to be used as a healthy cooking oil and the meal as a high-quality protein supplement for livestock. Canola name came from shortened of "Canadian oil low acid ". To another statement, "Can" for Canada and "o" for oil, and 'la' for low acid. • Canada began developing rapeseed with low levels of erucic acid in the oil in 1957 to meet the growing demand for cooking oil [1].

Canola is a crop with plants from three to five feet tall that produce pods from which seeds are harvested and crushed to create canola oil and meal. These plants also produce small, yellow flowers, which beautify the environment. Canola seeds contain about 45% percent oil.

Germination is the process of seeds developing into new plants. First, environmental conditions must trigger the seed to grow. When water is plentiful, the seed fills with water in a process called imbibition. Seed germination is first critical and at the same time the most sensitive stage in the life cycle of plants and the seeds exposed to unfavorable environmental conditions like drought stress may have to compromise the seedlings establishment [2].

After pollination, houses both a zygotic embryo that will form the new plant as well as a storage tissue to supply nutrients that support seedling growth following germination. One part of the seed, the embryo, begins to get energy from another part of the seed the endosperm. The embryo begins to grow a small root called the radicle downward to find moisture. A shoot called the plumula begins to grow upwards in search of light and air [3].

Canola oil is now the third largest source of edible oil following soybean and palm oil. Canola seeds contain about 45% oil. This large percentage of oil comes in small package, canola seeds are little big form in size to poppy seeds, though brownish black in color. Although they look similar, canola and rapeseed and their oils are very different in term of erucic acid content of seed. Canadian scientists used traditional plant breeding in the 1960s to practically eliminate two undesirable components of rapeseed-erucic acid from meal to create "canola", a contraction of "Canadian" and "ola" Canola oil is prized for its heart-healthy properties with the least saturated fat of all common culinary oils [4].

High salinity is a common abiotic stress factor that seriously affects the production of crops in some parts of the world, particularly in arid and semi-arid regions. About 8 million hectares of agricultural land worldwide are exposed to salt stress. One of the major variables contributing to salt accumulation and the resulting decline in agricultural productivity is irrigation with low quality water. In the end, salinity stress decreases plant growth, but plant species vary in their salinity tolerance. Various biotic and abiotic stresses limit successful cultivation of canola, with salinity being one of the major abiotic factors limiting production [5, 6].

Salinity is one of the environmental factors that has a vital impact on canola seed germination and the establishment of plants. Imbibition, germination and root elongation are impaired by salinity. However, the way NaCl influences these critical processes, whether by an osmotic effect or a particular ion toxicity, is still the same. Unresolved. Dimorphic canola seeds [7].

Soil salinity, which is a common problem in irrigated areas of Iran with low rainfall, is a major restriction to the seed germination and seedling establishment of canola. This problem has a negative impact on crop growth and development and contributes to low agricultural production. For a crop subjected to salinity, germination is one of the most important times. The germination of canola seeds can be affected by soil

salinity, either by creating an osmotic potential outside the seed to prevent water absorption or by the toxic effects of Na and Cl ions on the germinating seeds [8].

Bybordi et al. [9] expressed that plant growth is ultimately reduced by salinity stress, but plant species differ in their salinity tolerance and this effects come from either by creating an osmotic potential outside the seed to prevent water absorption or by the toxic effects of Na and Cl ions on the germinating seeds. According to their experimental study that the highest fresh and dry weights of roots and leaves were observed in control, while salinity at 200 mM decreased significantly both root and leaf weight during time [9]. Atis [10] stated that salt doses caused to delay the germination initiation time and even at low salt doses, root growth decreased especially. Shahbazi et al. [11] reached a result from investigating of effect of NaCl treatments on germination and seedling characteristics of canola cultivars that salinity stresses have been substantially impacted on germination percentage and a decrease in germination percentage was triggered by increased NaCl concentration.

The study will contribute knowledge and experience about the role of salinity in improving seed germination and seedling growth efficiency and productivity. Farmers can use the data to improve seedling productivity.

The objective of this study is to investigate how effect salinity levels on germination and seedling growth of some canola varieties approved officially in Turkey and cultivating in the winter season.

2. MATERIAL and METHODS

Canola seed used in the experiment provided DEKALB and PIONEER companies. Varieties name are PR44W29, DK EXTORM, NK LINUS, ES NEPTUNE. In the experiment used NaCl as Salt calculated doses. This experiment was carried out Laboratory Faculty Agriculture of Erciyes University.

This experimental study was carried out at the Laboratory of Faculty of Agriculture at Erciyes University in 2020. The experiment was laid out in Completely Randomized Design with two factors (four cultivars and six salinity levels), and each treatment replicated four times.

The experiment was conducted to observe the influence of different NaCl concentrations on germination, root and shoot length, hard seed and abnormal seedlings. The solution used for study consisted of 0 (as control), 5, 10, 15, 20 and 25% EC provided by mixing in pure water and 0, 2.75, 5.72, 9.00, 12.45 and 15.70 g NaCl. For each cultivar 50 seeds for each of six NaCl treatments were used Test Cabinet machine. Seed could germinate in laboratory condition on filter papers in packet plastic in solution of the respective salt concentration. The seed germination was investigated after every 24 h. Seed germination was started after 12 h (seed were germinated with emergence of the radical). The germinating seeds were counted at regular intervals. The lengths of root and shoot of the germinated seeds which were more than 2 mm in length were measured and recorded after 7 days, 10 plants from each box were randomly chosen and tagged for subsequent sampling. Root shoot and whole plant of seedling measured

All data were subjected to analysis of variance (ANOVA) using Completely Randomized Design with two factors and four replications using SPSS statistical program. F test was used to determine the significance of treatments, and Duncan Multiple Range test was used to compare mean values. Graphics regarding the effects of salt levels on each trait were drawn with Excel 2013.

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3. RESULTS

3.1. Germination Rate

Table 4.2 shows us that germination rate average of varieties changed between 26.3-75.6% According to Table 4.2 the highest germination rate (85.5%) DK EXTORM has taken 0 NaCl and NK LINUS the lowest germination rate found as (1.5%) with 25 ns NaCl dose germination rate.

According to germination rate, varieties were separated four groups (Table 1). From highest to lowest germination rates they ranked as DK EXTORM, PR44W29, ES NEPTUNE and NK LINUS, respectively. The germination rate was found as 62.0, 61.6, 52.5, 48.7, 37.9 and 20.1% at the salinity levels applications as 0 (as control), 5, 10, 15, 20 and 25% EC, respectively. And it was found as a lowest germination rate (20.1%) at the level of 25% EC which was differed from other salinity groups (Table 1). This result shows us that increasing salinity levels decrease germination rate.

Table 1. Germination rate (%) data provided from different doses of NaCl application on different varieties of canola

Salinity Levels (EC%)	Varieties of Canola				Means
	PR44W29	DK EXTORM	NK LINUS	ES NEPTUNE	
0	54.0	85.5	52.5	56.0	62.0[a]
5	59.0	83.0	45.5	59.0	61.6[a]
10	56.0	74.5	33.5	46.0	52.5[b]
15	49.5	80.5	17.0	47.8	48.7[b]
20	44.0	69.0	8.0	30.5	37.9[c]
25	13.5	61.5	1.5	4.0	20.1[d]
Means	46.0[b]	75.6[a]	26.3[d]	40.5[c]	47.1

It is possible to see the results of the effects of salinity levels on germination rate of the canola cultivars in Figure 1.

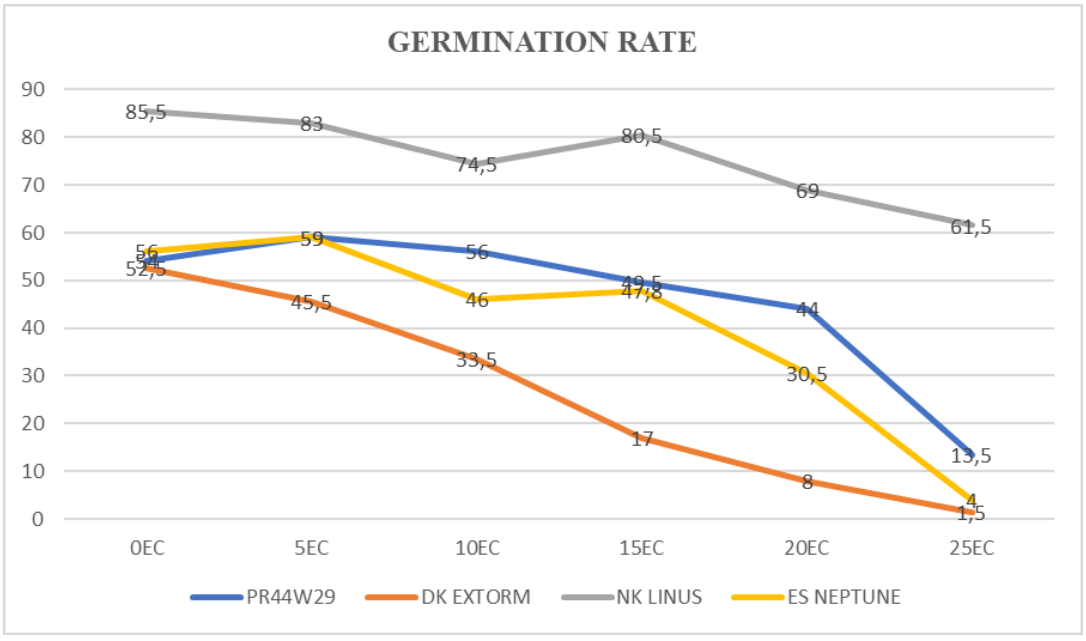

Figure 1. Germination rate of the canola cultivars subjected different salinity levels.

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3.2. Seedling Length

Seedling length of varieties changed between (18.9-50.3mm) According to Table 2 the highest seedling height (74mm) NK LINUS has taken 5 NaCl and PR44W29 and DK EXTORM the lowest seedling he found as 1.3-0mm 25EC NaCl dose seedling height.

Table 2. Seedling length (mm) data provided from different doses of NaCl application on different varieties of canola.

Doses of NaCl	Varieties of Canola				Means
	PR44W29	DK EXTORM	NK LINUS	ES NEPTUNE	
0	41.8	56.2	73.2	34.7	51.5[a]
5	34.6	59.3	74.0	31.4	49.8[a]
10	23.6	41.8	65.5	25.1	38.6[b]
15	15.1	19.9	45.5	19.5	24.9[c]
20	11.1	7.9	30.1	3.0	13.0[d]
25	1.3	0	13.7	0	3.7[e]
Mean	21.3[c]	30.8[b]	50.3[a]	18.9[c]	30.3

seedling length they ranked as DK EXTORM, PR44W29, ES NEPTUNE and NK LINUS, respectively. The seedling length was found as 51.1, 49.8, 38.6, 24.9, 13,3.7 at the salinity levels applications as 0 (as control), 5, 10, 15, 20 and 25% EC, respectively. And it was found as a seedling lenght (3.7%) at the level of 25% EC which was differed from other salinity groups (Table 4.5). This result shows us that increasing salinity levels decrease seedling length. Results of salinity levels on seedling length of the canola cultivars can be shown in Figure 2.

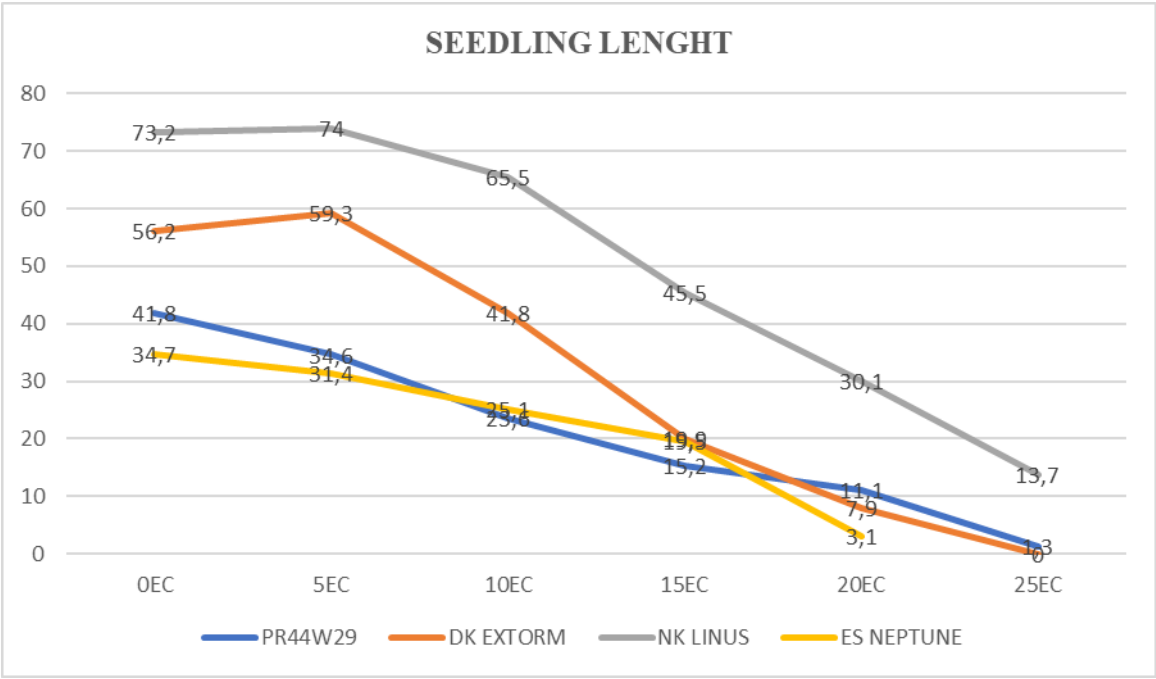

Figure 2. Seedling length of the canola cultivars subjected different salinity levels.

3.3. Root Length

The length of root average of varieties changed between (18.3-39.3mm) According to Table 3 the highest length of root (64.1mm) NK LINUS has taken 5 NaCl and ES NEPTUNE and DK EXTORM and PR44W29 the lowest length of root found as 25EC NaCl dose length of root.Page limit is 20 including all items.

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Table 3. Length of root (mm) data provided from different doses of NaCl application on different varieties of canola.

Doses of NaCl	Varieties of Canola				Means
	PR44W29	DK EXTORM	NK LINUS	ES NEPTUNE	
0	35.7	39.9	63.9	39.6	44.8[a]
5	46.3	29.8	64.1	33.8	43.5[a]
10	39.3	23.3	39.9	20.7	30.8[b]
15	17.2	12.9	37.0	16.9	21.0[c]
20	9.2	4.4	21.1	3.4	9.6[d]
25	0	0	10	0	2.7[e]
Means	24.8[b]	18.3[c]	39.3[a]	19.0[c]	25.4

According to length of root average, varieties were separated four groups (Table 3) From highest to lowest length of root they ranked as DK EXTORM, PR44W29, ES NEPTUNE and NK LINUS, respectively. The length of root was found as 44.8, 43.5, 30.8, 21, 9.6, 2.7 at the salinity levels applications as 0 (as control), 5, 10, 15, 20 and 25% EC, respectively. And it was found as the lowest length of root (2.7%) at the level of 25% EC which was differed from other salinity groups. Results of salinity levels on length of root of the canola cultivars can be shown in Figure 3.

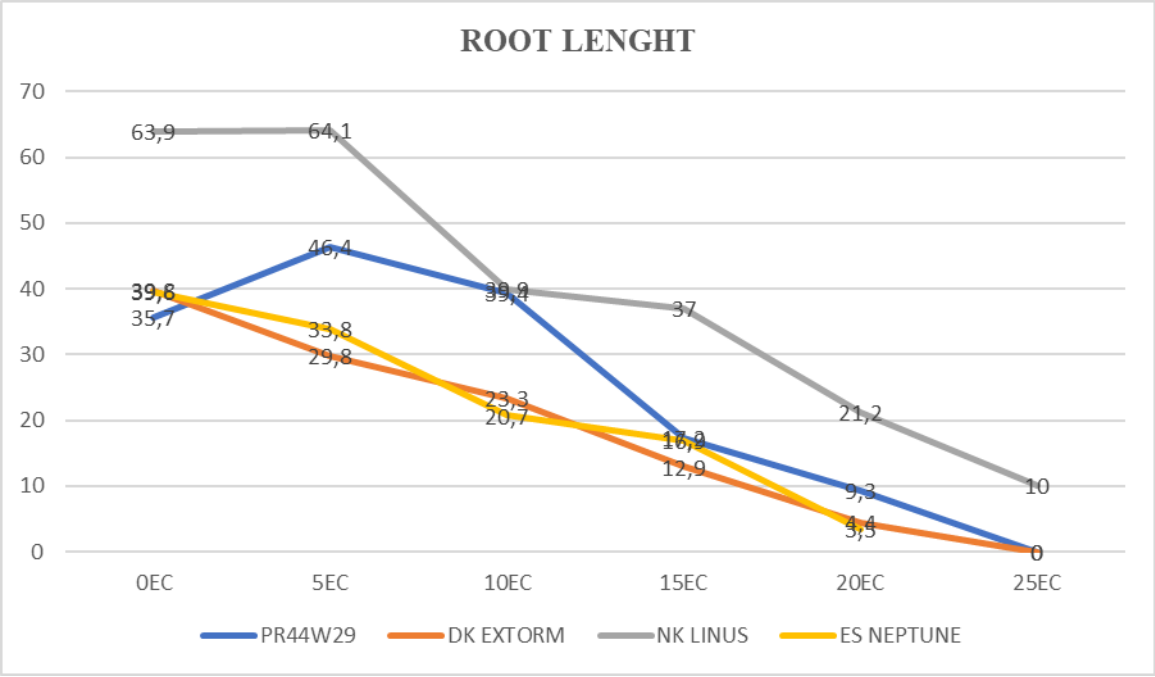

Figure 3. Root length of seedling of the canola cultivars subjected different salinity levels.

3.4. Fresh Weight

Fresh weight average of varieties changed between (44.2-91.4 g). According to Table 4 the highest fresh weight (125.9 g) NK LINUS has taken 5 NaCl and ES NEPTUNE and DK EXTORM the lowest fresh weight found as 0 25EC NaCl dose of fresh weight.

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Table 4. Fresh weight (g) data provided from different doses of NaCl application on different varieties of canola.

Doses of NaCl	Varieties of Canola				Means
	PR44W29	DK EXTORM	NK LINUS	ES NEPTUNE	
0	52.9	73.8	114.7	80.3	80.5[b]
5	81.1	78.6	125.9	74.5	90.0[a]
10	60.0	60.8	11.8	49.2	70.5[c]
15	41.3	32.4	79.5	38.0	47.8[d]
20	18.5	19.7	62.2	24.3	31.2[e]
25	26.9	0	54.2	0	20.3[f]
Means	46.7[b]	44.2[b]	91.4[a]	44.3[b]	56.7

According to fresh weight average, varieties were separated four groups (Table 4) From highest to lowest fresh weight rates they ranked as DK EXTORM, PR44W29, ES NEPTUNE and NK LINUS, respectively. The fresh weight was found as 80.5, 90, 70.5, 47.8, 31.2, 20.3 at the salinity levels applications as 0 (as control), 5, 10, 15, 20 and 25% EC, respectively. And it was found as a lowest fresh weight (20.3%) at the level of 25% EC which was differed from other salinity groups (Table 4). This result shows us that increasing salinity levels decrease fresh weight. The results of salinity levels on fresh weight of seedling of the canola cultivars can be shown in Figure 4.

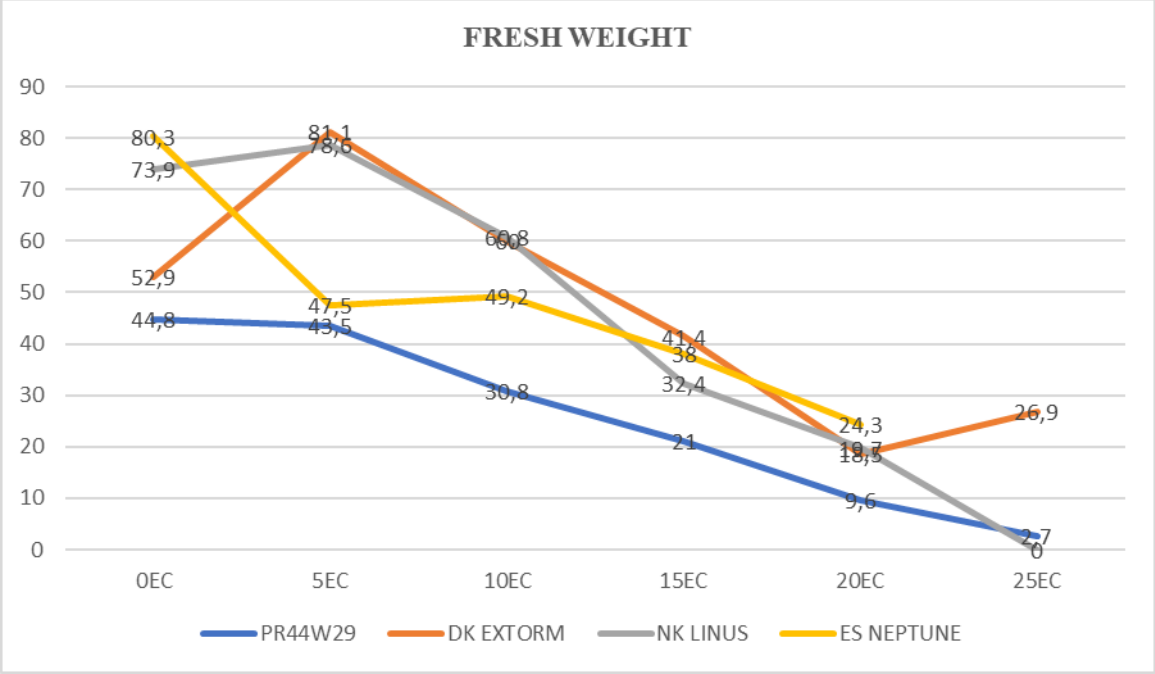

Figure 4. Fresh weight of seedlings of the canola cultivars subjected different salinity levels.

3.5. Dry Weight

Dry weight average of varieties changed between (2.5-4.9g). According to Table4.10 the highest dry weight (5.5g) NK LINUS has taken 20 NaCl and ES NEPTUNE and DK EXTORM the lowest dry weight found as 0 25EC NaCl dose of dry weight.

Table 5. Dry weight (g) data provided from different doses of NaCl application on different varieties of canola.

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Doses of NaCl	Varieties of Canola				Means
	PR44W29	DK EXTORM	NK LLINUS	ES NEPTUNE	
0	3.7	3.4	5.1	3.2	3.8[b]
5	4.5	4.0	3.4	2.9	3.7[b]
10	4.0	4.2	5.5	3.8	4.3[a]
15	3.6	3.3	5.0	2.5	3.6[b]
20	3.3	2.1	5.5	2.6	3.4[b]
25	2.7	0	4.9	0	1.9[c]
Means	3.6[b]	2.8[c]	4.9[a]	2.5[c]	3.5

The results of salinity levels on dry weight of seedling of the canola cultivars can be shown in Figure 4.3. According to dry weight average, varieties were separated four groups (Table 4.10) From highest to lowest dry weight they ranked as DK EXTORM, PR44W29, ES NEPTUNE and NK LINUS, respectively. The dry weight was found as 3.8, 3.7, 4.3, 3.6, 3.4, 1.9 at the salinity levels applications as 0 (as control), 5, 10, 15, 20 and 25% EC, respectively. And it was found as a lowest dry weight (1.9%) at the level of 25% EC which was differed from other salinity groups.

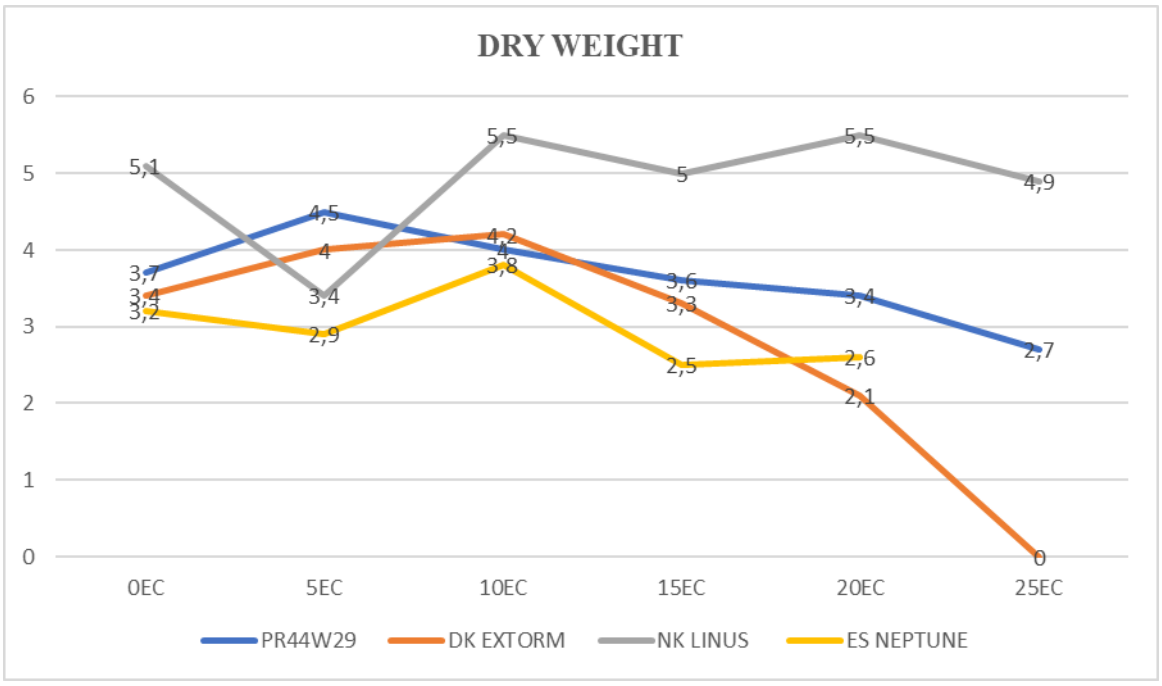

Figure 5. Dry weight of seedling of the canola cultivars subjected different salinity levels.

4. DISCUSSION

The present research was carried out in the Erciyes University Faculty of Agriculture, Plant Physiology Laboratory. Four different canola varieties and six doses applied in the study, germination rate, seedling, and root length, fresh weight and dry weight. The results of this study indicate that the levels of salinity had different influence on canola, and the canola cultivars had distinctive responses. This issue about effects of salinity levels and responds of canola varieties were discussed fallow by comparing others studies in short.

According to results of the present study, increasing salinity as created with applying different NaCl doses decreased germination rate, and germination rate as a means of varieties changed between 26.3-75.6% But,

responding of varieties showed differences in same degree and the highest germination rate was recorded as 85.5% at DK EXTORM cultivars with control (0 NaCl) application. This result was accordance with those of study by Jamil, et al. [13]. Kandil et al. [8] also reported that germination rate rapeseed varieties significantly affected from increasing NaCl doses and varied between 65.33-100.00%. Similar results were recorded from some other researches [14, 15, 16].

The substantial results of the present study were that the salinity caused significant reduction not only in germination rate, but also root lengths, seedling lengths, and fresh and dry shoot weights. In addition, the respond of the different canola varieties subjected increasing NaCl dose were different, too. These results are shown an agreement with those ones obtained from some other researches [9,16,18,19,20]. As a result of the present and the other studies decreasing of root and shoot lengths with increasing NaCl doses can be considered as the important indicators for salt stress. Jamil, et al. [13] also mentioned that root and shoot length provides an important clue to the response of plants to salt stress. These results obtained from the present study are in accordance with those of obtained by several researchers [8, 9,12,13,17,18]. These adverse effects of salinity on plant growth may also be due to ion cytotoxicity and/or osmotic stress and nutritional deficiencies [21].

5. CONCLUSION

The experiments were performed to examine the effect of salt stress and priming on initial growth of four rapeseed cultivars. The study was focused on to determine the effect of salinity on germination and seedling growth of some canola varieties. Thus, the objective of this study was to determine to evaluation of salinity on germination and seedling growth of 4 canola cultivars factorial experimental was carried out based on complete randomized design include 6 salinity levels (0,5,10,15,15,20, and 25 Mm NaCl) and 4 canola cultivars (PR44W29, NK LINUS, DK EXTORM, and ES NEPTUNE)) with 4 replications. In this experiment I measured every day how much seed are germinated after 7 days I measured the length of whole plant shoot and root.

As a result of this study conducted under controlled conditions. It has been determined that the tolerance of the varieties to different salts varies. Some winter canola varieties with different NaCl dose the effect on the germination of this in the study, increasing NaCl doses were statistically significant negative on characters. It had an effect on the variety x NaCl interaction significant. This study reveals that the effect of increasing NaCl doses on the examined characteristics varies according to the varieties. Low NaCl doses gives better result in terms of canola varieties germination rate, rootlet and often spur on shoot length than higher doses.

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The Declaration of Conflict of Interest/ Common Interest

No conflict of interest or common interest has been declared by the authors

The Declaration of Ethics Committee Approval

This study does not require ethics committee permission or any special permission.

The Declaration of Research And Publication Ethics

The author of the paper declares that he complies with the scientific, ethical, and quotation rules of ETOXEC in all processes of the paper and that he does not make any falsification of the data collected. In addition, he declares that Environmental Toxicology and Ecology and its editorial board have no responsibility for any ethical violations that may be encountered and that this study has not been evaluated in any academic publication environment other than Environmental Toxicology and Ecology.

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