T.C.
ERCIYES UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
DEPARTMENT OF AGRICULTURAL SCIENCES AND TECHNOLOGIES

THE EFFECTS OF SALINITY ON GERMINATION AND SEEDLING GROWTH OF SOME CANOLA VARIETIES

Prepared
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Supervisor
Prof. Dr. Ali İrfan İLBAŞ

Master Thesis

February 2021
KAYSERI

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COMPLIANCE WITH SCIENTIFIC ETHICS

I declare that all the information in this study was obtained in accordance with academic and ethical rules. I also state that I have fully cited and referenced all materials and results that are not inherent in this study, as these rules and behavior require.

UBAH YAKUB OSMAN

Signature ……………

The MSc thesis entitled **The Effects of Salinity on Germination and Seedling Growth of Some Canola Varieties** has been prepared in accordance with Erciyes University Graduate Education and Teaching Institute Thesis Preparation and Writing Guide

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That the acceptance of this thesis has been approved by the decision of the Institute's Board of Directors with the ………..……... date and ………………. numbered decision.

………. /……../ ………

Prof. Dr. Mehmet AKKURT

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THE EFFECTS OF SALINITY ON GERMINATION AND SEEDLING GROWTH OF SOME CANOLA VARIETIES

UBAH YAKUB OSMAN

Erciyes University, Graduate School of Natural and Applied Science
M.Sc. Thesis, February 2021
Supervisors: Prof. Dr. Ali İrfan İLBAŞ

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% 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 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).

Keywords: Canola, salinity, germination, seedling development, NaCl.

TUZLULUĞUN BAZI KANOLA ÇEŞİTLERİNDE ÇİMLENME VE FİDE BÜYÜMESI ÜZERİNE ETKİLERİ

UBAH YAKUB OSMAN

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Yüksek Lisans Tezi, Şubat 2021
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ÖZET

Bu çalışma tuzluluğun bazı kanola çeşitlerinde çimlenme ve fide büyümesi üzerine etkilerini belirlemek amacıyla yapılmışıt. Bu amçla, çalışma tam şansa bağlı faktöryel deneme deseninde, dört kanola çeşidi (PR44W29, NK LINUS, DK EXTORM, ES NEPTUNE) ve 6 tuzluluk seviyesi (0,5,10,15,20,25 EC, bu seviyeler sırasıyal 0, 2.75, 5.72, 9, 12.45 ve 15.70 g/l NaCl ilavesiyle elde edilmiştir) uygulamasıyla, dört tekerrülü olarak yürütülmüştür. Çalışmada, 7 gün süresince yapılan gözlemlerle çimlenen tohum sayısı, kök uzunluğu, sürgün uzunluğu, kök, sürgün ve tüm fide yaş ağılığı, kök, sürgün ve tüm fide kuru ağılığı tespit edilmiştir.

En yüksek çimlenme oranı (% 85,5) DK EXTORM, 0 EC tuzluluk seviyesi ile almış ve NK LINUS,% 25 ile% 1,5 olarak bulunan en düşük çimlenme oranıdır. EC uygulama düzeyi, gruplar arasındaki farklılıklar önemli değildir ($P <0.05$). En yüksek fide yüksekliği (74mm) 5EC seviyesi ile NK LINUS çeşidinden, PR44W29 ve DK EXTORM ise 25EC uygulama seviyesi ($P <0.05$) ile en düşük fide çeşidinden alınmıştır. En yüksek kök uzunluğu (64.1mm) 5EC seviyeli NK LINUS çeşidinden alınmıştır, ancak yüksek tuzluluk seviyesi uygulaması nedeniyle ES Neptune ve DK EXTORM ve PR44W29 çeşitleri 25EC tuzluluk seviyesi ile kök gelişimini arşivlememiştir ($P <0.05$). En yüksek taze ağırlık (125,9g) 5EC ile NK LINUS çeşidinden alınmıştır ve bulunan en düşük taze ağırlık (0 g, tüm fideler ölmüştür) ES Neptün ve Dk EXTORM 25 EC tuzluluk seviyesi uygulamasıyla ($P <0,05$). En yüksek kuru ağırlık (5.5g), 20EC tuzluluk seviyesine sahip NK LINUS çeşidinden alınmıştır ve ES Neptune ve Dk EXTORM çeşitlerinden kuru ağırlıklar ölçülmemiştir çünkü tohumlar yüksek seviyede tuzluluk uygulaması ile öldürülmüştür ve 25EC uygulama seviyesi ile en düşük kuru ağırlıklar (2.1 ve 2.7 g) sırasıyla DK EXTORM PR44W29 çeşitlerinde bulunmuştur. Genel olarak, tuz konsantrasyonu% 0 EC'den% 25 EC'ye yükseldiğinde çimlenme, fide uzunluğu ve taze ve kuru ağırlıklar bu deneyi kullanan kanola çeşitlerinin tüm kısımlarını önemli ölçüde azaltır.

Anahtar Kelimeler: Kanola, Tuzluluk, Çimlenme, Sürgün gelişimi, NaCl.

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ICONS AND ABBREVIATIONS

NaCl	Sodium Chloride
mm	Millimeter
ds/m	Deci Siemens per meter
g	Gram
EC	Electric Conductivity
%	Percentage
<	Greater than
>	Smaller than
GP	Germination Rate
hr.	Hour
°C	Degree Centigrade

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CHAPTER ONE

INTRODUCTION

1.1. History of Canola

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 (Stamm et al., 2018).

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 (Channaoui et al., 2017).

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 (Rajjou et al., 2012).

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 (Puppala et al., 1999).

Brief information about the effects of salinity on germination, growth and yield of canola plants:

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.

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 (Biology and Uni, 1998).

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 (Kandil et al., 2012).

Why we did this study?

As we know, the main reason we do research is to solve an existing problem or to discover new knowledge. So, this study will solve the problem of soil salinity on germination and seedling growth of some canola varieties.

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 study may provide new knowledge and can be a point of reference and may also open avenues for further research and for the researcher, it will give more in-depth knowledge in research and means to write a research paper on salinity germination and seedling growth of some canola varieties.

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.

CHAPTER TWO

GENERAL INFORMATION AND SUMMARY OF LITERATURE

This study focuses on the effect of salinity on germination and seedling growth of some canola varieties. This section was therefore discussing different theories and studies done before at the same topics.

Ibrahim et al. studied on impact NaCl on germination of rape varieties in 2017. They used NaCl in 4 different winter rape varieties, 8 different (0, 25, 50, 75, 100, 125, 150 and 200 mM) doses of salt and they studied the germination properties. Germination rate is between 65.3-100.0%. They reported that germination rates have changed according to application doses. The highest (100%) 25 mM salt dose decreases the germination rate. They observed that the lowest was obtained from the 200 mM dose. Check that it changes between 3.75-8.71 days, the shortest germination time with 3.75 days. The longest germination with 8.71 days at a salt dose of 200 mM, and they reported that low salt doses positively affect the germination time. However, they reported that increasing doses delay germination. The longest of the rootlets high 12.81 cm and 25 mM salt dose, shortest 0.50 cm and 200 mM salt dose that the decreases were sharp after 100 mM salt dose in all varieties. Have been observed. Similarly, if the highest shoot lengths are 25 mM, the shortest. They reported that the dosage of 200 mM salt. Egc 7571 type all examined characteristics. The Elvis variety is the least affected by salt doses in terms of salt doses determined as the most affected variety (Ibrahim et al., 2017).

Arslan and Aydınoğlu carried out the study on canola germination under the laboratory conditions to determine the response of two damson varieties to salt stress during germination in 2018. In this research, Ceora variety registered as a variety with low ODAP content with a local variety was used as the vegetal material. As a result of the study, it was found that salt stress reduced germination and early seedling growth characteristics. According to the results, the germination rate varied between 85-100%, stem length 12.55-77.74 mm, and stem length 23.30- 73.12 mm, root age weight 202.90-951.30 mg and peduncle age weight between 479.98-807.60 mg. It has been determined that damson plant provides an Acceptable germination even at 150 mM NaCl dose (Arslan and Aydınoğlu, 2018).

Atis (2011) carried out an experiment and examined the relationship between some barley varieties with salt doses during germination in the study in 2015. He applied 6 different doses of NaCl salt (0, 3, 6, 9, 12 and 15 g / l). The effects of salt doses in all parameters studied are statistically significant ($p < 0.01$) and increasing. They stated that salt doses delay the germination initiation time. Germination the highest rate was 95.6% in the control group, the lowest 75.8% with 15 g/l. When the salt dose and germination power are examined, the highest rate 97.8% in the control group, 85.9% in the salt dose of 15 g/l. They observed that at low salt doses in all varieties, root development and reported that it was good and root growth decreased with salt doses (Atis, 2011).

Stress factors in crop production cause a decrease in yield. Demirkol et al. carried out a study to determine the salinity tolerance of the feed pea genotype determined to be Suitable for feed use. Different NaCl doses (0, 30, 60, 90, 120, 150, 180, 210, 240, 270 and 300 mM) were applied in the study. The Trial Coincidence Plots was established in 10 replicates according to the trial pattern. In the study, germination rate, average germination time, length of radicle and plumula, fresh weight of radicle and plumula and dry weight of radicle and plumula were investigated. In the study, salt stress caused a statistically significant difference in all parameters. As a result, it has been found that the studied genotype is resistant to salt doses below 90 Mm (Demirkol et al., 2019).

Shahbazi et al. investigated effect of NaCl treatments on germination and seedling characteristics of canola cultivars was measured and its results thus obtained have been presented. Germination percentage Salinity stresses have been substantially impacted. A decrease in germination percentage was triggered by increased NaCl concentration. At all salinity levels, Hyola401 demonstrated the highest germination percentage. Hyola330 was rated, on the other hand, as the most sensitive cultivar to salinity stress. The seedling length did not have a major effect on 50 mM NaCl, but decreased with an increase in NaCl (Shahbazi et al., 2011).

2.1 Seed Viability

The viability of seeds is the ability of the embryo to germinate and is influenced by several different conditions. Many factors can affect seed viability such as viable seed production, predator damage and pathogens as well as environmental conditions such as flooding or heat.

The age of the seed also affects its health and ability to germinate. Seeds are living embryos, and over time the cells die and cannot be replaced. The length of time a seed remains viable can be influenced by both genetics and the environment. Some seeds can remain viable under optimal conditions for many years, and others for a seasonal cycle only. The viability of seeds is of particular importance for industries such as forestry and agriculture, as they depend on the germination of seeds.

Being able to predict seed viability is an important part of the planning process and ensures that resources are allocated where they are needed. In this lab, we will apply two methods to estimate seed viability. The first is based on visual inspection of seed quality, and the second method uses germination of a sample seed population to estimate viability (Shaban, 2013).

2.2. Seed Vigor

Seed viability is defined as "the sum of seed characteristics that determine the activity level and performance of the seed or seed lot during germination and seedling emergence". In any seed lot, losses in seed strength are related to the reduction in the ability of the seeds to perform all the physiological functions that allow them to perform.

This process, called physiological aging (or deterioration), begins before harvest and continues during harvest, processing and storage.

It gradually reduces performance, for example due to changes in cell membrane integrity, enzyme activity and protein synthesis. These biochemical changes can occur very quickly (several days) or more slowly (years), depending on genetic, production and environmental factors that are not yet fully understood (Bradbeer and Bradbeer, 1988).

2.3. Effect of Salinity

High salinity is a common abiotic stress factor that seriously affects crop production in some parts of the world, particularly in arid and semi-arid regions There are about of 8-million-hectare agricultural land exposure to salt stress in the world. Irrigation with poor quality water is one of the main factors that lead to salt accumulation and the resulting decrease in agricultural productivity. The plant growth is ultimately reduced by salinity stress, but plant species differ in their salinity tolerance (Bybordi and Tabatabaei, 2009).

Saline soils and saline irrigation waters pose possible dangers to the development of canola. Canola (Brassica napus L.) It is one of the world's and Iran's most valuable oil seed crops, and its production has been significantly expanded in recent years. 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 (Bybordi and Tabatabaei, 2009).

2.4. Effect of Salinity on the Properties of Water

Owing to infiltration and surface runoff, the salinity of rivers, lakes, oceans and groundwater shifts over time. Choosing the right frequency range for remote sensing applications is a very critical parameter for water salinity estimation. Its microwave dielectric properties are also influenced by the concentration of salts in water, as can be seen by comparing the complex permittivity of salty water with that of pure water at many frequencies. Because NaCl is the principal salt in seawater, Stogey, expressed in terms of normality and temperature, can obtain a rational approximation for the complex permittivity of seawater and saline water (Gadani et al., 2012).

2.5. Salt Tolerance

Due to increased salinity issues, the need to cultivate crops with higher salt tolerance has increased strongly over the last decade. In general, unless they are grown in saline environments, plants do not establish salt tolerance. This implies that it is important to harden them to salt stress. Salt tolerance of plants may be improved prior to sowing by treatment of seeds with NaCl solutions. While one of the physiological methods is priming, which improves seed output and provides faster and coordinated germination, it has been shown that NaCl priming may be used as a method of adaptation to improve seed salt tolerance. Working with tomatoes, working with cucumbers, it was concluded that seed priming enhances the germination of seeds, the emergence of seedlings and growth under saline conditions. Nevertheless, the beneficial effects of NaCl priming remain unknown for later plant growth and development phases. It stated that the benefits of NaCl priming did not persist beyond the cucumber seedling stage, while Cano et pointed out that, due to cultivars and salinity levels, NaCl priming had positive effects on mature plants and tomato yield. Although NaCl priming is a useful technique to increase salt tolerance of plants, it is very important to understand the physiological effect of this technique on plants, which mediate their responses to salinity. However, Physiological changes induced by NaCl priming, have scarcely been studied in plants and have concluded that the higher salt tolerance of primed (P) seed plants appears to be due to a higher osmotic adjustment capacity as P seed plants have more Na^+ and Cl^- in root sand, more sugars and organic acids in leaves than non-primed (NP) seed plants. Canola is a major oil crop that is often grown in arid and semi-arid regions of the world, such as Iran, where salinity is or is already a problem. The present study was conducted to examine the effect of NaCl priming at the seedling stage on the salt tolerance of canola and to assess the physiological effects of priming (Shahbazi et al., 2011).

2.6. Germination and Seedling Growth

Seed germination is usually the most critical stage in seedling establishment, determining successful crop production. Crop establishment depends on an interaction between seedbed environment and seed quality. The stand, subsequent growth and final yield of crop plants are decreased when the moisture supply is limited. Seeds sown in seedbeds having unfavorable moisture because of limited rainfall at sowing time yield in poor and unsynchronized seedling emergence affecting the uniformity of plant density with negative effects on yield (Okçu et al., 2005).

In arid and semi-arid regions, salinity has also been identified as the major seedbed factor influencing establishment. In saline soils with varying responses to species and cultivars, germination and seedling growth are reduced. By creating an external osmotic potential that prevents water absorption or due to the toxic effects of Na+ and Cl- ions on the germinating seed, salinity may also influence seed germination (El and Resources, 2011).

Okçu et al. studied on the relative significance of the osmotic or toxic effects of NaCl on pea seed germination in Turkey. This study was conducted to determine the effect of NaCl on the growth and germination of seedlings and to determine the factors responsible for seed germination failure under saline conditions compared to different levels of NaCl and PEG. Four drought stresses with different osmotic potentials of -2, -4, -6 and -8 bars were arranged as described by Michel and Kaufmann (1973). Salt concentrations that had the same osmotic potentials of -2, -4, -6 and -8 bars (electrical conductivities of the solutions were 4.5, 8.8, 12.7 and 16.3 ds m-1 respectively) were adjusted using NaCl according to Coons et al (1990) and distilled water served as a control. The result of this study showed that drought stress was induced by polyethylene glycol (PEG 6000) treatment in different salt levels (Okçu et al., 2005).

2.7. Seedling length

A quick, easy-to-measure index of these attributes of the seedling is needed. Nursery managers also need a seedling index, especially during the critical seedling harvesting season, to help them make cultural decisions during the growing season. Collectively, these seedling characteristics required for the success of reforestation have been called "seedling quality." Perhaps the best description of seedling quality has been "fitness for purpose" For reforestation purposes, seedling quality can be defined as those characteristics necessary for a seedling to survive and grow after planting out. With respect to field survival, several seedling attributes have been tested. Far less, however, is known about those needed for early growth, and the issue of adequate growth following planting has been ignored (Mexal, 1990).

It is possible to categorize measures of seedling quality in many ways. Separated seedling quality measures into two categories: attributes of material and attributes of results. Material attributes are clearly measurable, either morphological or physiological, and include the status of mineral nutrients and seedling measurements, such as height and diameter of the stem. Performance attributes are physiological tests measuring a specific seedling function, such as root growth potential or cold- hardiness (Mexal, 1990).

2.8. Length of Root

Root growth potential (RGP) has been widely used to predict successful planting during the seedling harvesting and shipping season. Such predictions, however, have limited usefulness because RGP and other physiologically based seedling quality indexes change significantly from lifting through storage. Seedling quality is particularly vulnerable after seedlings leave the fully controlled and monitored nursery environment and can deteriorate rapidly during shipping and field storage. Due to adverse planting conditions, even stocks with a high-quality rating may perform poorly (Fageria, 2006).

One specific rating index that will suffice in all situations may be possible to identify, but this is doubtful. In the context of defining the "target seedling," this paper discusses traditional morphological parameters, shoot height and stem diameter. It discusses how these culling criteria are related to nursery and field performance, relates them to other morphological and physio-logical measurements of seedling quality, and explains how nursery cultural practices affect them (Newman, 1966).

2.9. Fresh Weight

Precise weight determination is essential for the duplication and repetition in various laboratories of experiments conducted with the same GPR/PGPB strain. Most fresh weight determinations are usually eliminated by reviewers when presented in a manuscript during the peer review process and are discouraged by editors (Huang et al., 2017).

We hypothesized that fresh weight determination is inherently faulty while dry weight is, by definition, accurate. For all experiments, both fresh and dry weights were determined, and water content was calculated for shoot, root, and whole plant. All data were subjected to analysis of variance, together with correlation and regression analyses between fresh weight and dry weight, to show the solidity of each type of determination (Huang et al., 2017).

2.10. Dry Weight

The parts which cannot be harvested in a certain sense are ballast but often a necessity, as they serve to provide the product to be harvested with essentials for its development. A large part of these correlations is genetically fixed, and this applies especially to the interspecific differences. Within the genetically fixed limits, however, exterior conditions may have a modifying effect. An example may be found on the leaf shape of lettuce which is dependent on light intensity as well as on nitrogen supply. The physiological phenomenon that forms the basis of these correlations is a growth correlation of the various organs. This article is mainly restricted to a description of these corer Latinos and some suppositions as to their plant-physiological background. Regarding the title of this article, this seems a subtle change in meaning, for, growth and dry-matter increase are not synonymous. This is only the case in so far as the dry-matter percentage is constant. Roughly, this is indeed the case. Possible deviations will receive attention, while at the same time these very deviations are interesting owing to the possibilities they offer to the physiological interpretation (Brouwer, 1962).

2.11. Practical Research Problems

Practical research is directly relevant to a particular problem that more broadly affects an organization, institution, social group or society. You can ask yourself in order to make it clear why your research problem matters:

- If the problem is not solved, what will happen?
- Who can feel the implications?
- Does the problem have wider relevance (e.g., are similar issues found in other contexts)?

Finally, how you plan to fix the issue should be framed by the problem statement. Your goal should not be to find a definitive solution, but to search for more efficient approaches to solving or recognizing the reasons behind the issue and the intent.

2.12. Importance of Research

The study be able to improve the performance of seed germination and seedling growth as the study may provide an understanding of the current weakness in the process of seed germination due to the soil salinity.

The results of the study will benefit farmers by contributing 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. To the academia, the study may provide new knowledge and can be a point of reference and may also open avenues for further research and for the researcher, it will give more in-depth knowledge in research and means to write a research paper on salinity germination and seedling growth of some canola varieties.

The study results may contribute to the body of knowledge regarding the salinity on germination and seedling growth by presenting significant factors that support farmers in improving productivity in the seed germination process. Knowledge of soil salinity is crucial for farmers because a salinity on germination has the potential to impact productivity and performance in the seed germination process. The research results may provide knowledge and relevant information for farmers and academics to help them enhance performance in the field as well as filling a gap in the literature.

2.13. Purpose of the Research

Therefore, the objective of this study was to determine the salinity assessment on germination and seedling growth of 4 factorial experimental canola cultivars based on complete randomized design, including 6 salinity levels and 4 canola cultivars with 4 replications.

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

CHAPTER THREE

MATERIAL AND METHOD

3.1. Materials

Learn about the biological history of the first one (PR44W29 PIONEER) it provides high oil yield together with high grain yield. Also, it highly tolerant of winter damage. The 2nd type of canola that I use (NK LINUS) it differs with its unopened pod feature. It has high germination and output power also it is resistant to cold during the rosette period. The 3rd one is (DK EXSTORM) hybrid Canola seed with high disease tolerance, yield and winter conditions tolerance.

The last type that I used (ES-NEPTUNE OIL SEED RAPE) sowing objective: quick and homogenous emergence, autumn and preparation for winter, also winter entrance and frost tolerance. Seed used in the experiment provided DEKALB company 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.

3.2. Methods

3.2.1. Experimental Design and Salt Application

The germination experiment 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. 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.

The first stage of germination, called water imbibition. Occurs when the seed is exposed to water. The seed absorbs water though its seed coat. As this happens, the seed coat softens. Next, water triggers the seed to begin converting starch to sugar. Such four cultivars (PR44W29, DK EXTORM, NK LINUS, ES NEPTUNE) were used, which are predominantly grown in Turkey.

Table 3.1 The salt was mixture the pure water:

Salinity Levels (EC%)	**NaCl**
O EC	00
5 EC	2.75 g
10 EC	5.72 g
15 EC	9.00 g
20 EC	12.45 g
25 EC	15.70 g

Figure 3.1 Salt solved.

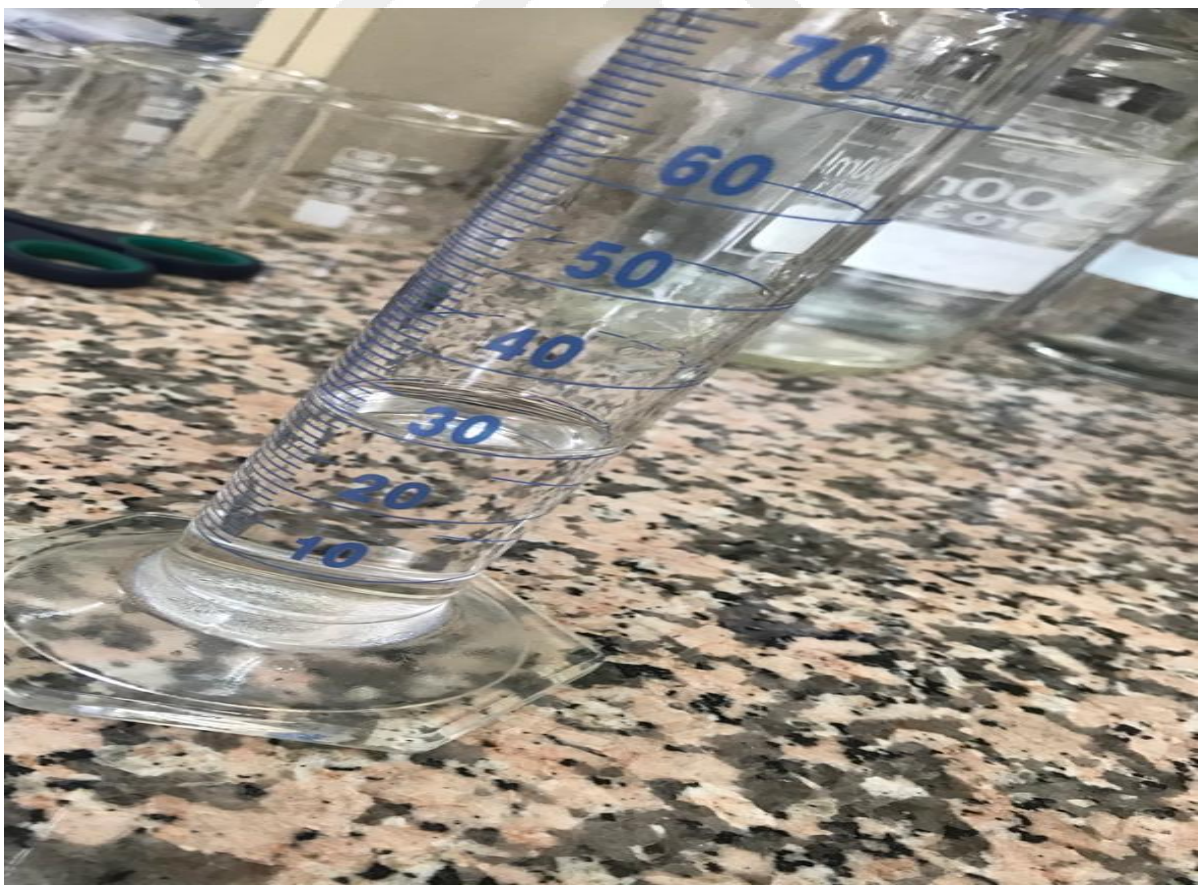

Figure 3.2 plastic measuring tube liquid

Figure 3.3 controlled humidity test-changes the moisture levels.

Figure 3.4 Laboratory glass bottles.

Measurements and Analyzes

Germination rate: Germination Presentence (GP)=seeds germinated/total seeds*100 is the equation for calculating germination percentage. The rate of germination provides a measure of the seed germination process over time. The germination rate is calculated by measuring the GP after planting at different time intervals and then collecting the data. And I counted how many seeds germinated 24 h of 20 c per day, every single day.

Figure 3. 5 these pictures are the 1rst day and the last day of germination.

Length of root: The root length in the measured line algorithm is determined by counting the number of pairs of pixels connected orthogonally and diagonally. In each root diameter class, root lengths were calculated using a ruler.

Figure 3 6 A ruler, or line gauge, is a device used in geometry and technical drawings, as well as engineering.

Height of seedling: The height of the plants in experiments was measured on a 7th day basis with a measuring tape. The measurement was taken from the base of the stem to the shoot apical meristem. Plant height measured with the aid of ruler.

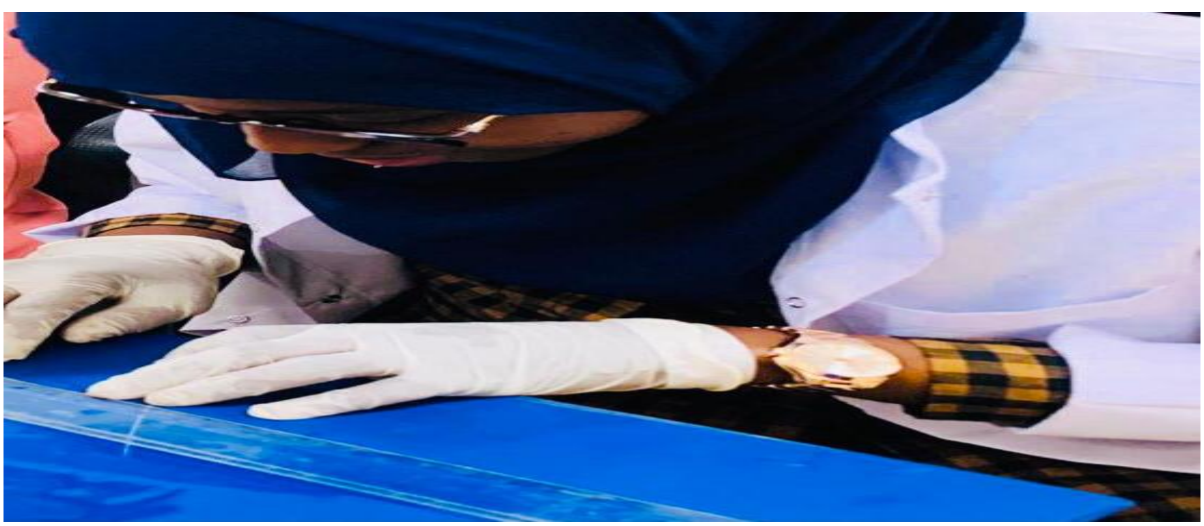

Figure 3. 7 Ruler drawing straight lines and measuring the height.

Fresh weight: Fresh weight = weight recorded immediately after the plant or part of a plant is harvested. 7 day after inoculation, fresh weight of seedling and roots were measured on a scale (0.01g) that show in the below:

Figure 3. 8 Ohaus corporation manufactures balances and scales for the laboratory, education, industrial and specially markets worldwide.

Dry weight: When a small of living tissue is weighted, we get fresh weight. Dry weight when water evaporated from a living tissue and then the tissue is weighted, we get dry weight.

Figure 3 9 roots and seedling were carefully I washed with pure water to salinity.

Figure 3 10 then the samples were dried in an oven at 70C for 72hr when constant weight was reached.

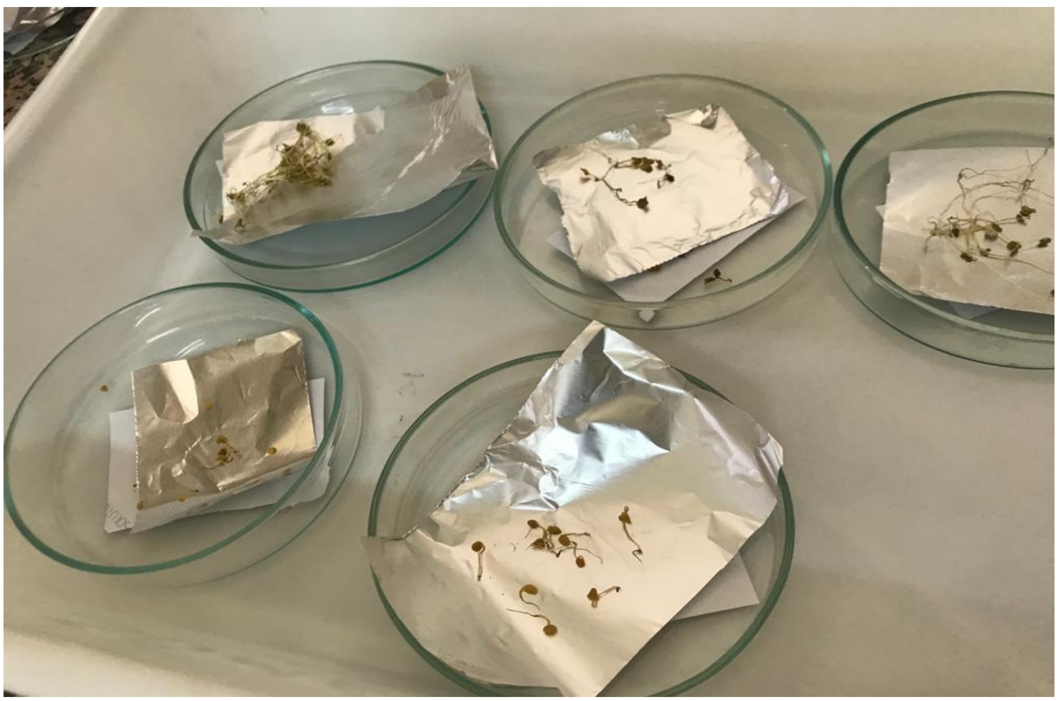

Figure 3 11 Dried shoots and roots were weighted on a scale g and whole plant was calculated.

3.3. Statistical Analysis.

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.

CHAPTER FOUR

RESULTS

4.1 Germination Rate

The variance analysis results of germination rate are given in the Table 4.1. When the Table 4.1 is examined, varieties, salt doses and variety x salt doses interaction were found statistically significant at the 0.05 level.

Table 4.1 Variance analysis results of germination rate.

Variation Resource	**Degrees of Freedom**	**Sum of Square**	**Mean Square**	**F Value**
Varieties	3	30996.615	10332.205	323.760*
Salt doses	5	20438.552	4087.710	128.088*
Varieties x Salt doses	15	3828.323	255.222	7.997*
Error	72	2297.750	31.913	-
Total	95	57561.240	-	-

*: $P < 0.05$

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 4.2). 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 4.2). This result shows us that increasing salinity levels decrease germination rate.

Table 4.2 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

Results of salinity levels on germination rate of the canola cultivars can be shown in Figure 4.1.

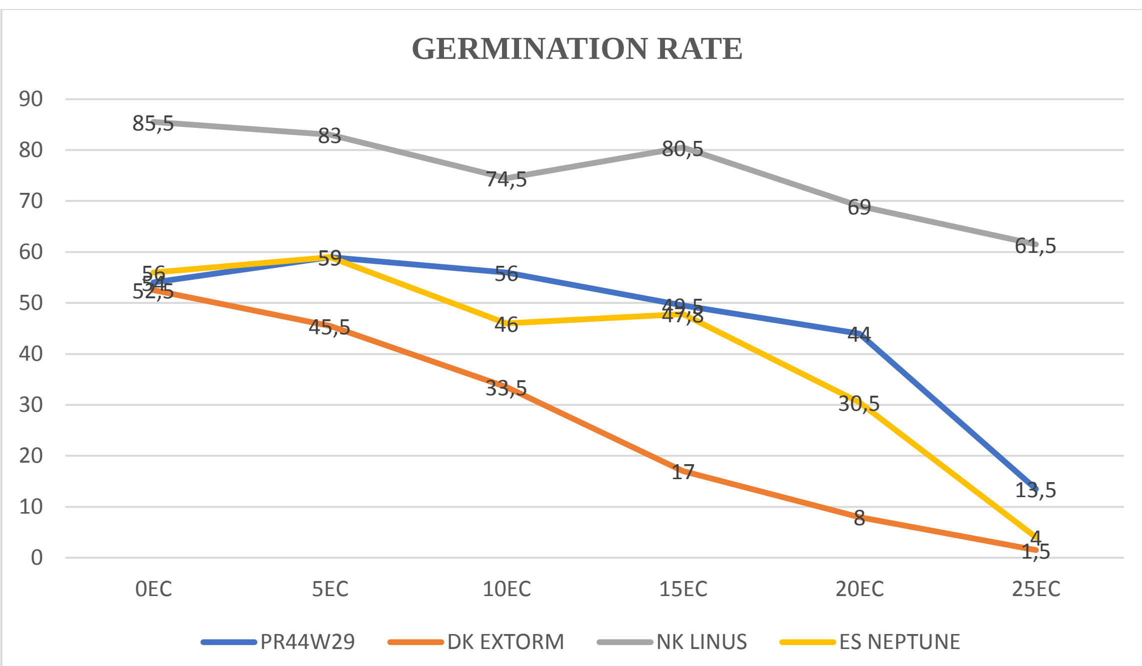

Figure 4.1 Germination rate of the canola cultivars subjected different salinity levels.

4.2. Seedling Length

The variance analysis results of seedling length are given in the Table 4.3. When the Table 4.3 is examined, varieties, salt doses and variety x salt doses interaction were found statistically significant at the 0.05 level.

Table 4.3 Variance analysis results of seedling length.

Variation Resource	Degrees of Freedom	Sum of Square	Mean Square	F value
Varieties	3	14673.797	4891.266	181.057*
Salt doses	5	30978.808	6195.762	229.344*
Varieties x Salt doses	15	2847.235	189.816	7.026*
Error	72	1945.087	27.015	-
Total	95	50444.927	-	-

*: $P < 0.05$

Seedling length of varieties changed between (18.9-50.3mm) According to Table 4.5 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 4.4 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

According to seedling average, varieties were separated four groups (Table 4.5 From highest to lowest 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 length (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 4.2.

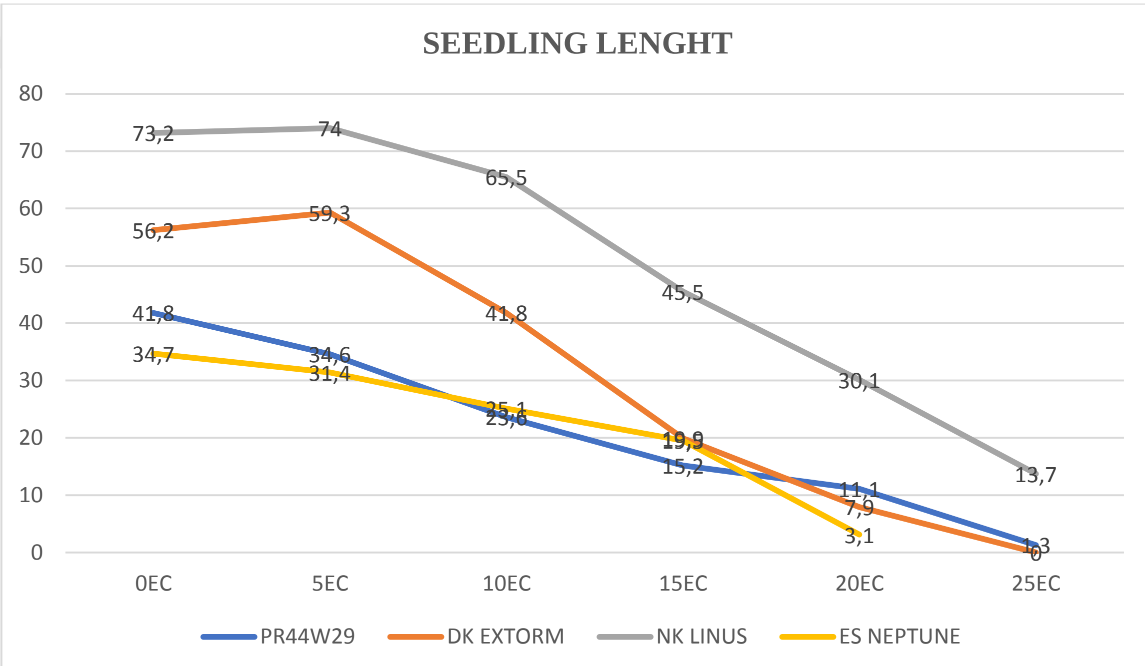

Figure 4.2 Seedling length of the canola cultivars subjected different salinity levels.

4.3. Root Length

The variance analysis results of length of root are given in the Table 4.5. When the Table 4.5 is examined, varieties, salt doses and variety x salt doses interaction were found statistically significant at the 0.05 level.

Table 4.5 Variance analysis results of length of root

Variation Resource	Degrees of Freedom	Sum of Square	Mean Square	F value
Varieties	3	6819.697	2273.232	56.544*
Salt doses	5	24261.403	4852.281	120.696*
Varieties x Salt doses	15	1784.944	118.996	2.960*
Error	72	2894.585	40.203	-
Total	95	35760.630	-	-

*: $P < 0.05$

Length of root average of varieties changed between (18.3-39.3mm) According to Table4.7 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.

Table 4.6 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 4.7) 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 4.3.

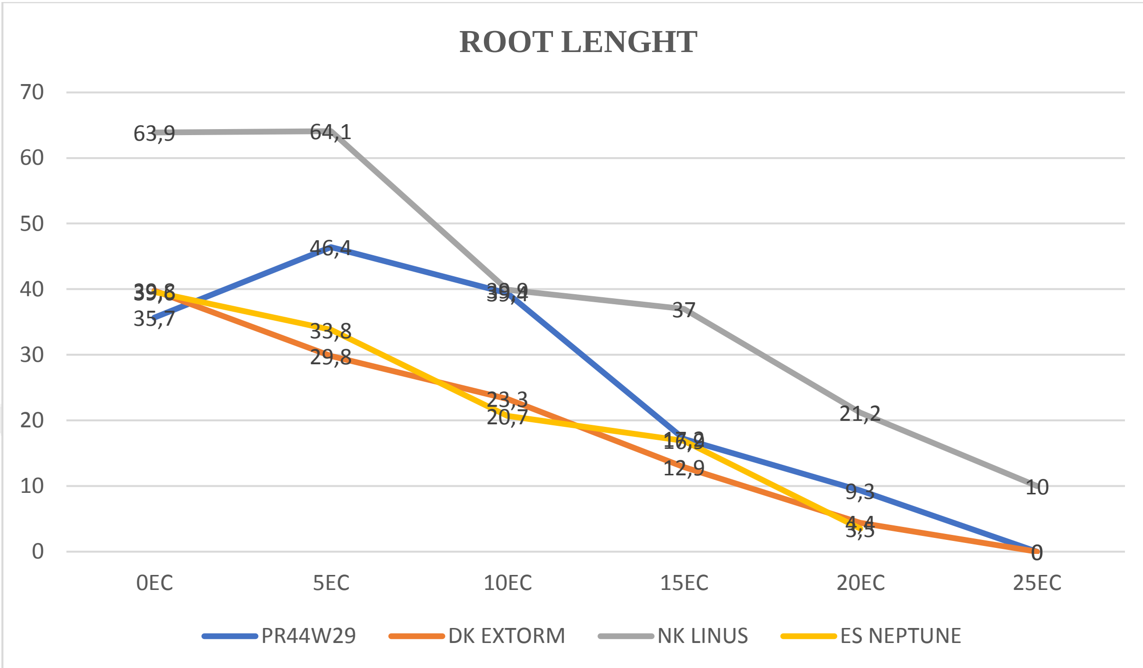

Figure 4.3 Root length of seedling of the canola cultivars subjected different salinity levels.

4.4. Fresh Weight

The variance analysis results of fresh weight are given in the Table 4.7. When the Table 4.7 is examined, varieties, salt doses and variety x salt doses interaction were found statistically significant at the 0.05 level ($P<0.05$).

Table 4.7 Variance Analysis Results of Fresh Weight

Variation Resource	Degrees of Freedom	Sum of Square	Mean Square	F Value
Varieties	3	38605.889	12868.630	309.266*
Salt doses	5	62761.491	12552.298	301.664*
Varieties x Salt doses	15	4502.836	300.189	7.214*
Error	72	2995.933	41.610	-
Total	95	108866.149	-	-

*: $P < 0.05$

Fresh weight average of varieties changed between (44.2-91.4 g). According to Table 4.8 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.

Table 4.8 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 4.8) 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 4.8). 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 4.4.

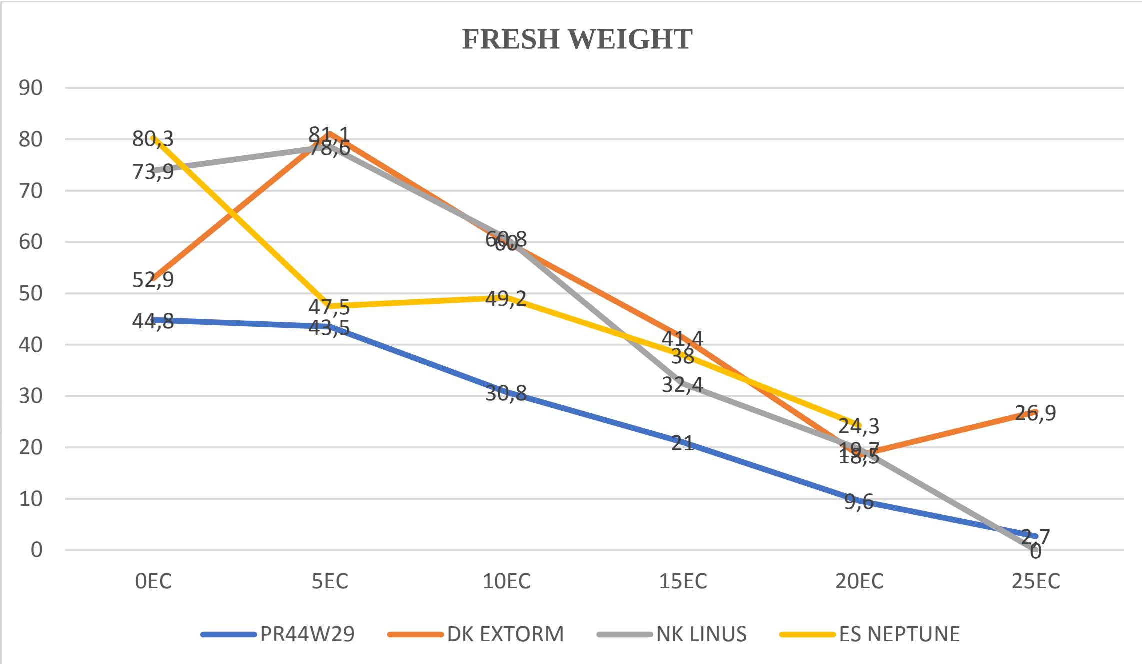

Figure 4.4 Fresh weight of seedlings of the canola cultivars subjected different salinity levels.

4.5. Dry Weight

The variance analysis results of dry weight are given in the Table 4.9. When the Table 4.9 is examined, varieties, salt doses and variety x salt doses interaction were found statistically significant at the 0.05 level.

Table 4.9 Variance analysis results of dry weight.

Variation Resource	Degrees of Freedom	Sum of Square	Mean Square	F Value
Varieties	3	81.959	27.320	50.087*
Salt doses	5	55.661	11.132	20.409*
Varieties x Salt doses	15	48.222	3.215	5.894*
Error	72	39.272	.545	-
Total	95	225.115	-	-

*: $P < 0.05$

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 4.10 Dry 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 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.

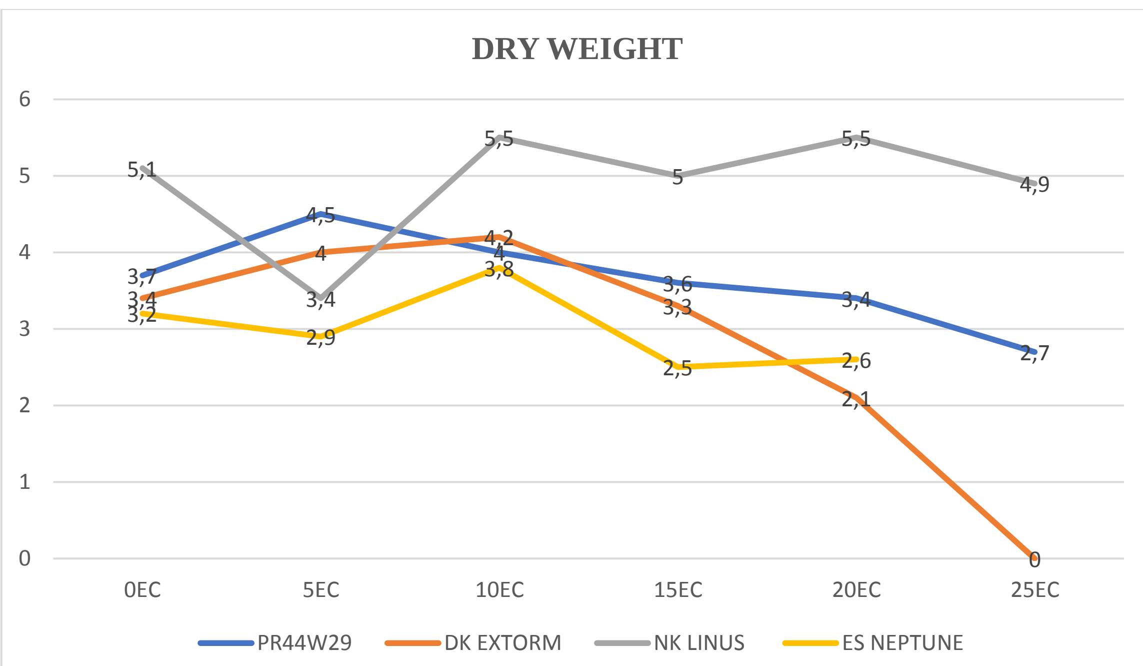

Figure 4.5 Dry weight of seedling of the canola cultivars subjected different salinity levels.

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.

CHAPTER FIVE

DISCUSSION AND CONCLUSION

Research, Erciyes University Seyrani Faculty of Agriculture, Department of Agricultural Science and Technologies, Graduate Education and Teaching Institute, Erciyes University

It was carried out in the laboratory. Four different canola varieties and six doses applied in the study, germination rate, seedling, and root length, fresh weight and dry weight.

The analysis of the variance showed non-significant variations between treatments (different salinity levels), ($P<0.05$) cultivars and interaction (salinity-cultivars) regarding the effects over all characters. These results indicate that the levels of salinity had different influence. And the cultivars had distinctive responses.

Germination Rate:

Different sodium chloride and doses percentage ranged from 26.3% to 75.6%. The highest germination rate 85.5% in DK EXTORM as found 0 NaCl While it is observed in ES NEPTUNE variety the 1.5% as 25 EC lowest germination.

Similar results: germination rate rapeseed varieties from increasing NaCl doses significantly affected and germination rate the varieties varied between 65.33-100.00%.

Highest germination rate (100%) Triangle variety of 25 mM NaCl dose, while this 0 and 25 mM of Es Hydromel and Elvis varieties

The value in the NaCl dose (98.66%) followed. This with the lowest germination rate (65.33% and 66.66%) 200 mM of Elvis and Es Hydromel varieties. It was obtained in NaCl doses (Ibrahim et al., 2017).

Seedling Length

When salt and dose interaction is examined, the highest seedling length (74 mm) NK LINUS variety with a value of 1.3-0 mm and dose of 25 EC of NaCl PR44W29 and DK EXTORM is the shortest seedling length.

Similar Result: Rape cultivars with different NaCl doses their length varied between 0.59-8.79 cm. Most long shoot (8.79 cm) 25 mM of Egc 7571 variety the shortest shoot length when seen at the NaCl dose (0.59 cm) Elvis variety at 200 mM NaCl dose measured (Ibrahim et al., 2017).

Root Length

Different levels of salinity in canola varieties root lengths obtained under stress conditions.

Average values of between 18.3 and 39.3 mm have changed. Salt stress root length values depending on the decreased significantly (P <0.05). When root length values are examined NK LINUS is the highest root length (64.1 mm) and PR44W29 and DK EXTORM was died all plants in 25 EC NaCl because of high salinity.

Similar Result: Different levels of salinity in damson varieties root lengths obtained under stress conditions. Average values of between 12.55 and 77.74 mm has changed Drought stress root length values depending on the increase decreased significantly (P <0.01).

When root length values are examined, local root length of the variety (37.85-77.74 mm)

Higher than the Ceora variety (12.55-39.07 mm) seems to be (ARSLAN and AYDINOĞLU, 2018).

Fresh Weight

When the effects of NaCl salt doses on varieties are examined, fresh weight (144.2-91.4 g) the highest value is 125.9 g / plant with a dose of 5 EC and NK LINUS variety has been observed. Due to the increase in salt doses in DK EXTORM and ES NEPTUNE varieties seedling fresh weight decreased, some increase in low salt doses in other varieties A decrease was observed with increasing salt doses.

Dry Weight

When the averages obtained between (2.5-4.9g) while the highest dry weight 5.5g in NK LINUS variety at salt dose 20NaCl. DK EXTORM and ES NEPTUNE while showing the same information 0 it means died all the plant. there was no significant development.

CONCULUSION

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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