**THE EFFECTS OF DİFFERENT CHEMİCAL AND ORGANİC FERTİLİZERS ON THE DEVELOPMENT OF PLANTAL PROPERTİES İN COTTON (*G.hirsutum* L.) UNDER NORMAL AND SALTY SOİL CONDİTİONS**

**CEVHER İLHAN CEVHERİ1**

1Harran University, Faculty of Agriculture, Department of Field Crops, Sanliurfa, Turkey

Corresponding author’s email: icevheri@harran.edu.tr

**Abstract**

This study, the effects of organic and chemical fertilizers applied in normal and salty soil conditions on the physiological development of cotton were investigated. In the study; the effects of organic and chemical fertilizers applied to two cotton (*Gossypium hirsutum* L.) varieties were grown in normal and salty soils conditions to chlorophyll content, plant height (cm), root length (cm), root wet weight (g), general dry weight (g) root dry weight (g) was studied. The experiment was designed according to randomized blocks design with three replications, as a pot experiment. Candia and Lima cotton varieties were used as plant material in the study. According to the results obtained from the study; In normal soils, the lowest chlorophyll value (17.83) from control; and the highest chlorophyll value (32.64) was obtained from chemical fertilizer (DAP) application. In salty soils, the lowest chlorophyll value (20.33) from chemical fertilizer (DAP) application; The highest chlorophyll value (24.11) was determined from worm fertilizer application. In normal soils; the shortest plant height (27.83 cm) from chemical fertilizer (DAP) application. The highest plant height (33.00 cm) were obtained from cattle manure application. In salty soils; the lowest overall wet weight value (13.68 g) was obtained from worm manure applications and the highest general wet weight value (16.81 g) was obtained from chemical fertilizer (DAP) application. In normal soils; the lowest general dry weight (2.48 g) from cattle manure the highest overall dry weight (3.13 g) was obtained from the worm manure application. In salty soils, the lowest overall dry weight (1.93 g) was obtained from worm manure; The highest overall dry weight (2.38 g) was obtained from chemical fertilizer (DAP) application. According to the results of the research, it has been determined that normal soil conditions are more advantageous in terms of plant growth than salty soil conditions.

**Key Words:** cotton (*Gossypium hirsutum* L.), normal and salty soil condition, organic and chemical fertilizer, some hisyolojical properties.

**Introduction**

Cotton (*Gossypium hirsutum* L.), is a very important raw material for the textile industry in Turkey and the world, according to the National Cotton Council 2019 cotton sector report, at the 2018/2019 in Turkey, 2.57 million tons seed cotton were produced, If on average, 38 % of the produced seed cotton yield is considered as fiber cotton, it turns out that 976 thousand tons of fiber cotton is produced. Our country's cotton fiber sufficiency rate is around 50% (Anonymous, 2020). Cotton plant is an industrial plant produced in normal and semi-arid regions. Cotton plant needs plenty of water and fertilizer during and vegetative and generative periods. In particular, excessive application of fertilization and irrigation leads to an increase in the salt content of the soil. Salinity prevents the plant from especially germination, root growth, stem growth and the development of vegetative parts. It is very difficult and costly to treat salted soils and to eliminate their harmful effects. Cotton is a product grown in irrigated areas, and soil salinity is seen intensely in these areas. Soil salinity; As a result of excessive and unconscious use of water and soil resources, it has become a very important production problem. Approximately 20% of the agricultural land produced today and 50% of the irrigated areas are affected by salinity (Zhu, 2001). As is known, cotton plants are grown in irrigated farming areas. The problem of salting, which has increased in these areas especially in recent years, is seen all over the World. Since the removal of salinity in the soil today is extremely expensive, it is necessary to focus efforts on obtaining varieties that are tolerant to salinity. Salt stress is considered as one of the main abiotic stress factors that limit plant growth.

Due to the different irrigation systems, agricultural lands affected by high salinity have been increasing and three major threats occur, namely osmotic stress, ionic stress and oxidative stress (Munns et al., 2008; Flowers & Colmer, 2008). In the production increase of cotton, which is an important product for our country, besides cultivating high genetic potential good varieties with high yield potential, optimizing growing conditions is another important factor. The first stage of high yield and quality production in cotton is the optimum germination of the seeds sown, ensuring optimum plant density in the unit area and adequate development (Fujikura et al., 1993; De Villiers et al., 1994). Especially, varieties that are resistant to salt stress should be grown. Because it takes a lot of time to recover salty areas and is not preferred because of its high cost. Usually salinity decreases the vegetative development of cotton (Qadir & Shams, 1997). Low salt concentrations can increase growth (Pessarakli & Tucker, 1985; Gorham, 1996). Salt stress reduces the leaf area and the development of the root and above-ground parts in cotton (Saghir et al., 2002). With the salt density reaching 12 ECe, a decrease in germination rate and plant height had detected (Phogat et al., 2001). Germination rate decreased at 252 meq / l NaCl level and seedling growth was prevented even at lower densities (Casenave et al., 1999). Salinity is one of the important problems of the world lands. The disposal of 10 million ha of land in the world every year under the salinity effect reveals the size of the problem better (Kwiatowski, 1998). Soil salinity affects around 95 million hectares of agriculture in the world (Szabolcs, 1994). Salinity is a major threat to world agriculture and limits cotton production areas (Saghir et al., 2002). In agricultural production; plant, soil and water always takes place on the basis of the work. Combining these three factors rationally and efficiently will increase the efficiency obtained from the unit area. Soil-water relationship is very important. Excessive irrigation of the soil will increase the salt concentration and hinder the development of the plant. Especially in cotton farming, the high salt concentration in the soil negatively affects the physiological development of the plant. One of the leading causes of salinity in arid and semi-arid regions is insufficient precipitation and high evaporation too. Although rare, salinity can be seen in the delta plains near the ocean due to the ocean effect. On the other hand, improper irrigation applications can cause salinity especially in places where drainage conditions are bad (Ergene, 1982). Considering that the land opened to agriculture in the world is limited and the need for food increases exponentially, it turns out that at least the existing lands should be used more efficiently. For this reason, the rehabilitation and economic evaluation of soils with high salt concentration is extremely important (Woods, 1996). The use of salinity water and chemical fertilizers in plant production causes an increase in soil salinity (Epstein et al., 1980). Salinity stress is one of the most important abiotic stress factors that negatively affect growth and development (Allakhverdiev, 2000).

The aim of this study is to measure the plant's resistance against chemical and organic fertilizers applied to different cotton varieties under normal and saline conditions and to observe different growth parameters of the plant starting with germination. With this study, salinity resistance was determined of some cotton varieties under normal and salinity conditions. As a result of the study, it was aimed to determine the salt resistant cultivar and fertilizer combinations. Because in both normal and salty conditions, varieties and applications that perform highly against chemical and organic fertilizer applications will be recommended to producers.

**MATERIAL and METHOD:**

**Material**

In the study; Delinated seeds of Candia and Lima cotton cultivars were used as plant material**.** In the study; Solid farm fertilizer (Biofarm Fertilizer), Worm Fertilizer (Ecosolfarm) as organic fertilizer , DAP (18-46-0 composite) fertilizer was used as chemical fertilizer.Fertilizer doses were applied 2000 kg ha-1 solid farm manure, 1500 kg ha-1 worm manure, 300 kg ha-1 DAP (compound) fertilizer. No fertilizer applied to the control plots.

**Method:**

This study was designed according to the randomized plot experiment as pot experiment. The study consists of 2 main parts. The first part is the germination test, and the second part is the vegetative characteristics of the plant vegetation until the squaring period.

Candia and Lima cotton varieties were used for ressistant to salinity testing in normal and saline soils in this study carried out in the plant laboratory of Harran University Sanliurfa Technical Sciences Vocational School in May 2019. Germination test; It was conducted under laboratory conditions according to ISTA rules. In order to prevent contamination of cotton seeds, surface sterilization was performed with 70% ethanol for 30 seconds. Then it was kept in pure water for surface sterilization. After this process, the seeds were kept in 2% sodium hypochlorite solution for 3-5 minutes, and surface sterilization was achieved by washing 2-3 times in sterile distilled water again. Seeds with surface sterilization were sown in pots containing control and fertilizer according to the test pattern. Plants were harvested 12 weeks after emergence. Fertilizers were applied to pots at the doses specified in their package inserts. The soils used in the research were taken from areas with normal agricultural land and saline areas. When the chemical properties of the soils used are examined; in normal soils pH: 7.82, lime: 10.96, organic matter: 3.03 and Ec (ms cm-1) value is 0.88; In saline soils, pH: 7.20, lime: 26.62, organic matter: 3.74, and Ec (ms cm-1) value was determined as 3.40. The soils used in the experiment were passed through a 2 mm sieve and filled into pots of 5 kg. After sown, watering was applied to the pots to ensure germination. The water requirement of the plants was observed and irrigation was applied in different periods. Pure water with a pH close to 7 was used in the irrigation process. The trial was watered twice a week with distilled water. The temperature of the growing environment is adjusted to be 27 ± 1 °C per day (Reddy et al., 2004; Salvucci & Crafts-Brandner, 2004). The lighting of the environment where the plants were grown is arranged as 14 hours light and 10 hours dark. Sunlight and fluorescent light were used for the luminous phase. Trial was creat DAP chemical fertilizer applications, cattle manure and worm manure aplications and control conditions where fertilizer is not applied. The research was established according to random parcels experiment design with 3 repetitions. The process from planting to squaring was observed. Plants whose cotyledon leaves completely reached the soil surface were counted.

In the study; (1) Total amount of chlorophyll (%), (2) Plant height (cm), (3) Plant root length (cm), (4) Overall wet weight (g), (5) Root wet weight (g), ( 6) Results have been found by measuring and weighing the plant samples taken from each pot for general dry weight (g) and (7) root dry weight (g). The data obtained in the study, Variance analysis was done with JMP 13.0 program, the differences and groupings between the variables were determined according to LSD test.

**Results and Discussion**

**Results**

As seen in Tables, as a result of the analysis of variance, various statistical differences were found in terms of the characteristics examined as a result of growing cotton varieties in normal and salty soils. According to the physiological development parameters examined under normal soil conditions, germination was achieved in all fertilizer applications and when the plants reached a certain physiological development, they were examined in terms of the characteristics subject to the study. According to the physiological development parameters examined in saline soil conditions, germination could not be achieved in all fertilizer applications. Due to salty soil, cotton germination and physiological development were provided only in chemical fertilizer (DAP) and Worm fertilizer application and analyzed in terms of the parameters examined.

**Total Chlorophyll Ratio:** Total chlorophyll measurement of plants grown in pot conditions was made with SPAD device. When we look at the SPAD values, it is an expected development that a statistically difference occurs in cotton development stages. It is an expected situation that chlorophyll amount will be high especially during the squaring period when the plant has the highest physiological development. There was no statistically significant difference between the chlorophyll values in cotton cultivars grown under normal soil conditions from Table-1. There was a 0.01 level difference among chlorophyll values in terms of fertilizer applications. In terms of the fertilizers used, the lowest chlorophyll values were obtained from 17.83 (control) and the highest total chlorophyll value 32.64 (DAP fertilizer) application. A difference of 0.01 was found according to cultivar \* fertilizer interaction. In terms of variety \* fertilizer interaction, the lowest total chlorophyll value was obtained from Candia variety \* control application (17.44) and the highest chlorophyll value was obtained from Candia variety \* DAP fertilizer application (37.90). There was no statistically significant difference between varieties in cotton grown in salty conditions with different fertilizer applications. In terms of applied fertilizers, a statistical difference of 0.01 was found. The lowest total chlorophyll value (20.33) was obtained from the application of DAP fertilizer and the highest total chlorophyll value (24.11) from the application of worm fertilizer. A difference of 0.01 was found according to cultivar \* fertilizer interaction. The lowest total chlorophyll value was obtained from Candia variety \* DAP fertilizer application (18.60) and the highest total chlorophyll value was obtained from Candia variety \* Worm manure application (24.63). According to these results, there was no significant difference between the varieties. The different chlorophyll values according to fertilizer applications is a positive and meaningful development. In addition, it is significant that the chlorophyll ratio of the plants examined in normal soils is higher than the plants in salty conditions. In applications with high nitrogen doses, obtained high SPAD values mean that the rate of photosynthesis is high and organic material production is high. Plants have the opportunity to perform more photosynthesis in normal soil conditions and in optimum nutritional environment. Shankar et al. (2020)'s findings that the SPAD values increased between 41 and 45 values as a result of nitrogen application at 60, 90, 120 and 150 kg ha-1 doses, and that the SPAD values increase as a result of the increase in nitrogen doses findings are similar our findings. Our findings are in line with the findings of Doğru & Canavar (2019), which state that soil salinity reduces the pigment amount and photosynthetic activity of plants and consequently growth rate. According to the results obtained by Mitsuya et al. (2000) with the electron microscope, salt stress causes some changes in the chloroplast structure and reduces photosynthetic activity, for example, in the mesophilic cells of the potato plant applied with salt stress, the thylakoid membranes in the chloroplasts and the high salt concentrations in the chloroplasts. It is in harmony with the studies that state that it caused its complete disintegration. Our findings, in some other studies by Kennedy & Filippis (1999), Khavari-Nejat & Mostofi (1998), Alamgir & Ali (1999), total chlorophyll and protochlorophyllite in Greviela arenaria, total chlorophyll and chlorophyll in tomato, Bruguiera parviflora ' Chlorophyll a and chlorophyll b are in agreement with their studies, which reported that the total amount of chlorophyll decreased compared to control plants. It is in agreement with Johnson (2000)'s studies reporting that one of the most obvious effects of salt stress on plants is changes in photosynthetic pigment biosynthesis. Bhagwat et al. were made In the study of (2020) with different cotton varieties in saliny conditions, poor germination and subsequent abnormal plant development were observed under severe saline conditions, membrane stability (%), leaf relative water content (RWC) (%), chlorophyll content, photosynthesis Their findings that the rate, carotenoid content, perspiration rate and stomatal conductance were significantly reduced were consistent with our findings. In addition, the findings of Castilo (2011) in her research between 2006 and 2010 that stomatal conductance, photosynthesis and carbohydrate formation decreased as a result of excessive salt concentration are in accordance with our findings. Our findings that fertilizers applied in saline conditions and cotton varieties used in the experiment did not provide full physiological development, Hemphill et al. (2006) contrasted with the findings that the cotton plant is a relatively resistant plant in salt tolerance, so that the cotton plant has the potential to perform physiological development in saline conditions where salt stress can occur.

Table 1. The Effects of Fertilizers Applied in Normal and Salty Soil Conditions on Total Chlorophyll Ratio, Values Obtained and Groups of Variability Coefficients (CV%) Based on LSD Test

|  |  |  |  |
| --- | --- | --- | --- |
| Investigated Features | Fertilizers Application | Normal Soil | Salty Soil |
| Varieties | Varieties |
| Candia | Lima | means | Candia | Lima | means |
| 1. Chlorophyll | 1.DAP | 37.90a | 27.40cd | 32.64 | 18.60d | 22.06c | 20.33 |
| 2. Cattle manure | 29.73b | 27.66c | 28.70 | - | - | - |
| 3. Worm Manure | 25.50d | 25.37d | 25.43 | 24.63a | 23.60b | 24.11 |
| 4.Control | 17.44e | 18.23e | 17.83 | - | - | - |
| Means | 27.64 | 24.66 | 26.15 | 21.61 | 22.83 | 22.22 |
| CV(%), LSD | CV(%):4.39 LSD (Çeşit):n.s. LSD (Gübre):1.44\*\* LSD (Çeşit x Gübre):2.04\*\* | CV(%):1.02 LSD (Çeşit):n.s. LSD (Gübre):0.36\*\* LSD (Çeşit x Gübre):0.51\*\* |

There is no significant difference between the averages in the same letter group compared to LSD (5%). n.s:no significant. \*: Important at the 5% level; \*\*: Important at 1% level.

**Plant Height:** Under normal soil conditions from Table 2; There was no statistical difference between the varieties in terms of plant height. A statistically significant difference of 0.01 was found in terms of the fertilizers applied. In fertilizer applications, the lowest plant height (cm) value was obtained from 27.83 (DAP fertilizer) application and the highest plant height (cm) value was obtained from 33.00 (cattle manure) application. Variety \* fertilizer interaction was not statistically significant. There was no statistically significant difference between the variety and fertilizer applications in salty soil conditions. The plant height of the plants grown in salty soil conditions remained shorter. Plants grown in salty conditions did not develop as in optimal conditions. This situation led to the conclusion that saline soil did not create a suitable environment for plant growth. According to the results obtained from our study, the highest plant height was obtained from cattle manure application in normal soils. Jackson et al. (2003)'s findings that organic fertilizers improve the physical and chemical properties of the soil as well as increase the number of microbial communities, diversity and activity in the soil are in line with our findings. Khaliq et al. (2006)'s findings that the use of organic and microbial fertilizers are effective in the intake of nutrients created similarities with our findings. Again, our findings, Barrick et al. (2015) in their study to measure the effect of salinity on cotton lines in two soils in organic and conventional conditions, the results that the cotton plant is a product affected by various stress conditions, including salinity, and that salt applications have a negative effect showed on all examined properties, except chlorophyll content. Also; The findings of Castilo (2011), in his research between 2006 and 2010, that salinity has become a limiting factor in plant agriculture and that abiotic stress caused by salinity has a negative effect on plant growth is in accordance with our findings.

Table 2. The Effects of Fertilizers Applied in Normal and Salty Soil Conditions on Plant Height (cm), Values Obtained and Groups of Variability Coefficients (CV%) Based on LSD Test

|  |  |  |  |
| --- | --- | --- | --- |
| Investigated Features | Fertilizers Application | Normal Soil | Salty Soil |
| Varieties | Varieties |
| Candia | Lima | means | Candia | Lima | means |
| 2.Plant Height (cm) | 1.DAP | 24.33 | 31.33 | 27.83c | 24.00 | 27.00 | 25.50 |
| 2 Cattle manure | 32.33 | 33.66 | 33.00a | - | - | - |
| 3. Worm Manure | 30.33 | 33.33 | 31.83ab | 26.00 | 23.66 | 24.83 |
| 4.Control | 25.66 | 32.00 | 28.83bc | - | - | - |
| Means | 28.16 | 32.58 | 30.37 | 25.00 | 25.33 | 24.16 |
| CV(%), LSD | CV(%):9.40 LSD (Çeşit):n.s. LSD (Gübre):3.55\* LSD (Çeşit x Gübre):n.s | CV(%):16.18 LSD (Çeşit):n.s. LSD (Gübre):n.s LSD (Çeşit x Gübre):n.s. |

There is no significant difference between the averages in the same letter group compared to LSD (5%). n.s:no significant. \*: Important at the 5% level; \*\*: Important at 1% level.

**Root Length:** from Table 3; under normal soil conditions There was no statistically significant difference between the varieties examined in terms of root length is understand. A statistically significant difference of 0.05 was found in terms of the fertilizers used. In terms of fertilizers used, the lowest root length (cm) value was obtained from 13.66 (control application) and the longest root length (cm) value 16.00 (DAP chemical fertilizer) application. Variety\* fertilizer interactionwas statistically significant at the level of 0.01. In terms of varietyr \* fertilizer interaction, the lowest root length (cm) value was obtained from 13.00 (Lima variety \* control) application and thelongest root length (cm) value was obtained from 18.00 (Lima variety \* control) application. There was no statistically significant difference between cotton varieties grown in salty conditions and fertilizers used in production. The reason for this is that salty soil does not opportunity the root and aboveground parts of the plant to develop. Our findings are consistent with the finding of Abdel-Aziz (2019) that fertilization methods differ in plant growth rate (g/m2/week) in their cotton study to determine the effects of humic acid and bacillus bacteria on some physiological and productivity characteristics. Again, our findings Carter (1975); Flower (2005); Munns (2002); Pitman & Läuchli (2002); Sharma & Goyal (2003) It is in accordance with the findings stating that the harmful effects of salinity on plants become evident especially in arid and semi-arid climates and germination and vegetative growth factors are affected by these salt conditions. Our findings; Ashraf (2004); Mittler, (2006); and Neumann (1997), In the studies of in which they investigated the salt resistance of plants, it is in agreement with the findings that soil salinity and local environmental conditions variying, and salinity and local environmental conditions creat a problem in cotton production.

Among the reviewed literatures, Amjad et al. (2002) reported that root lengths were not affected by low salt density and that this length did not change with of increased salt density; Jafri and Ahmet (1994); Leidi (1994) reported that root length increased at low salt concentrations. This result has not been matching our own result. The reason of this; The different soil and climatic conditions under which the trials were conducted may have resulted from different cotton varieties and different cultural practices.

Table 3. The Effects of Fertilizers Applied in Normal and Salty Soil Conditions on Root Length (cm), Values Obtained and Groups of Variability Coefficients (CV%) Based on LSD Test

|  |  |  |  |
| --- | --- | --- | --- |
| Investigated Features | Fertilizers Application | Normal Soil | Salty Soil |
| Varieties | Varieties |
| Candia | Lima | means | Candia | Lima | means |
| 3. Root Length (cm) | 1.DAP | 16.00ab | 16.00ab | 16.00 | 12.73 | 16.00 | 14.36 |
| 2 Cattle manure | 15.66abc | 13.66cd | 14.50 |  |  |  |
| 3. Worm Manure | 13.33cd | 18.00a | 15.66 | 17.33 | 15.33 | 16.33 |
| 4.Control | 14.33bcd | 13.00d | 13.66 |  |  |  |
| Means | 14.83 | 15.08 | 14.95 | 15.03 | 15.66 | 15.34 |
| CV(%), LSD | CV(%):9.32 LSD (Çeşit):n.s. LSD (Gübre):1.73\* LSD (Çeşit x Gübre):2.45\*\* | CV(%):11.85 LSD (Çeşit):n.s. LSD (Gübre):n.s.LSD (Çeşit x Gübre):n.s. |

There is no significant difference between the averages in the same letter group compared to LSD (5%). n.s:no significant. \*: Important at the 5% level; \*\*: Important at 1% level.

**General Wet Weight (g):** Under normal soil conditions from Table 4; There was no statistical difference between the varieties examined in terms of the general age weight of the plant. In addition, there was no statistical difference in terms of the fertilizers used. We believe that the fact that there is no difference between the cultivars and the fertilizers used in terms of general age weight may be due to physiological and environmental effects. In salty conditions, no statistically significant difference was found between the cultivars in terms of general wet weight (g). A statistical difference of 0.01 was found in terms of fertilizers used in saliny conditions. Again, a statistically significant difference of 0.01 level was found in terms of variety \* fertilizer interaction in salty conditions. In terms of fertilizers used in salty conditions, the lowest general wet weight (g) value was obtained from 13.68 (Worm manure) application and the highest general wet weight(g) value was obtained from 16.81 (DAP fertilizer) application. In terms of variety \* fertilizer interaction, the lowest general wet weight (g) value was obtained from 13.00 (Lima variety \* Worm manure) application and the highest general wet weight (g) value was obtained from 17.33 (Lima variety \* DAP fertilizer) application. Although the general plant wet weight is at a certain level in salty conditions, growth under normal conditions could not be achieved. The vegetative parts of the plant could not develop in the desired scale in salty conditions. It is a known fact that saline soils do not have optimal conditions for plant growth. Taghipour and Salehi, (2008) As a result of the application of calcium chloride and sodium chloride to 12 barley varieties; reported that exile wet weight decreased. This result is consistent with our own result, but not with the findings of the same researchers that some varieties studied are resistant to all salt concentrations. In addition, Basal (2010) found in a study that significant differences were observed between the increased salt level and 15 cotton genotypes for all the characteristics examined, Findings of Vamadevaiah (2011) that cotton genotypes provide vegetative development without salt stress. consistent with our findings. Avcı et al. (2020) reported that the plant wet weights of cotton varieties taken to the experiment at different salt concentrations in vitro decreased, whereas the plant wet weight increased in normal soil conditions (control). Our findings In a study conducted by Abdel-Aziz (2019) in order to determine the effects of humic acid and bacillus bacteria on some physiological and productivity properties of a cotton variety, it is compatible with the finding that fertilization methods increase the wet weight of the plant. Our findings are in agreement with the findings of the researchers listed above. Nevertheless, Khenifi et al. (2011)'s findings that cotton genotypes provide vegetative growth under salt stress are not in agreement with our findings.

Table 4. The Effects of Fertilizers Applied in Normal and Salty Soil Conditions on General Wet Weight (g), Values Obtained and Groups of Variability Coefficients (CV%) Based on LSD Test

|  |  |  |  |
| --- | --- | --- | --- |
| Investigated Features | Fertilizers Application | Normal Soil | Salty Soil |
| Varieties | Varieties |
| Candia | Lima | means | Candia | Lima | means |
| 4. General Wet Weight (g) | 1.DAP | 15.53 | 17.63 | 16.58 | 16.30b | 17.33a | 16.81 |
| 2. Cattle manure | 18.44 | 15.86 | 17.15 |  |  |  |
| 3. Worm Manure | 18.60 | 17.46 | 18.03 | 14.36c | 13.00d | 13.68 |
| 4.Control | 21.80 | 14.36 | 18.08 |  |  |  |
| Ortalama | 18.59 | 16.33 | 17.46 | 15.33 | 15.16 | 15.24 |
| CV(%), LSD | CV(%):15.40 LSD (Çeşit):n.s. LSD (Gübre):n.s. LSD (Çeşit x Gübre):n.s. | CV(%):1.33 LSD (Çeşit):n.s. LSD (Gübre):0.32\*\* LSD (Çeşit x Gübre):0.44\*\* |

There is no significant difference between the averages in the same letter group compared to LSD (5%). n.s:no significant. \*: Important at the 5% level; \*\*: Important at 1% level.

**Root Wet Weight (g):** From Table 5; under normal soil conditions; In terms of root age weight (g) of the plant, a statistically significant difference was found at the level of 0.01 among the cultivars. A statistically significant difference of 0.01 level was found in terms of the organic and chemical fertilizers used. In addition, a statistically significant difference of 0.01 level was found in terms of variety \* fertilizer interaction. İn addition, a statistically significant difference of 0.01 level was found in terms of variety \* fertilizer interaction. Root wet weight (g) of plants belonging to Candia variety was higher. The difference in root wet weight between varieties may have been due to genetic structure, environment and the interaction of environment and genotype. In terms of fertilizers used, the lowest root wet weight (g) value, 0.92 from cattle manure application and the highest root wet weight (g) value were obtained from 1.10 (worm manure) applications. In the experiment where worm fertilizer was applied under normal soil conditions, root wet weight was the highest with 1.10 g. In terms of variety \* fertilizer interaction, the lowest root wet weight (g) value was obtained from 0.71 (Lima variety \* control) application and the highest root wet weight (g) value was obtained from 1.25 (Lima variety \* Worm fertilizer) application. In salty conditions, there was no statistically significant difference between the examined cotton varieties in terms of root wet weight (g) of the plant, but a statistical difference of 0.01 level was found in terms of fertilizers used in production. In addition, a statistical difference of 0.01 level was found in terms of variety \* fertilizer interaction. In terms of fertilizers used, the lowest root wet weight (g) value was obtained from the application of 0.70 (worm fertilizer) and the highest root wet weight (g) value of 0.83 (DAP fertilizer). In terms of applied fertilizers, DAP application (chemical fertilizer) was the highest with 0.83 (g) In terms of variety \* fertilizer interaction, the lowest root wet weight (g) value was obtained from the application of 0.68 (Lima variety \* Worm manure) and the highest root wet weight (g) value of 0.86 (Lima variety \* DAP fertilizer). Root wet weight (g) decreased as a result of salt density. During the vegetative development period of the cotton plant, root development increases in parallel. The roots are the first organ of the cotton plant to interact with salt due to its contact with the soil. Therefore, roots are affected by salt concentration. According to the results we obtained from the study; Worm fertilizer application revealed the highest root wet weight. Our results were similar with Jackson et al. (2003)'s findings that organic fertilizers improve all physical and chemical properties of the soil as well as increase the number of microbial communities, diversity and activity in the soil. Khaliq et al. (2006) in his study; The findings that the use of organic and microbial fertilizers are effective in the intake of nutrients have been similar to our findings. Our Findings, Reinhardt & Rost, (1995a); Reinhardt & Rost, (1995b); Raia & Azimov, (1988); Meloni et al. (2001); Ashraf & Ahmad, (2000); It was found similar to the results of the researchers named Munns (2002) stating that salt density negatively affects root growth and weight.

Table 5. The Effects of Fertilizers Applied in Normal and Salty Soil Conditions on Root Wet Weight (g), Values Obtained and Groups of Variability Coefficients (CV%) Based on LSD Test

|  |  |  |  |
| --- | --- | --- | --- |
| Investigated Features | Fertilizers Application | Normal Soil | Salty Soil |
| Varieties | Varieties |
| Candia | Lima | means | Candia | Lima | means |
| 5. Root Wet Weight (g) | 1.DAP | 0.97c | 0.94c | 0.96 | 0.81b | 0.86a | 0.83 |
| 2. Cattle manure | 1.07b | 0.78d | 0.92 |  |  |  |
| 3.Worm Manure | 1.09b | 1.25a | 1.10 | 0.72c | 0.68d | 0.70 |
| 4.Control | 1.25a | 0.71d | 0.98 |  |  |  |
| Meanz | 1.09 | 0.89 | 0.99 | 0.77 | 0.77 | 0.70 |
| CV(%), LSD | CV(%):4.06 LSD (Çeşit):0.07\*\* LSD (Gübre):0.05\*\* LSD (Çeşit x Gübre):0.07\*\* | CV(%):1.90 LSD (Çeşit):n.s. LSD (Gübre):0.02\*\* LSD (Çeşit x Gübre):0.02\*\* |

There is no significant difference between the averages in the same letter group compared to LSD (5%). n.s:no significant. \*: Important at the 5% level; \*\*: Important at 1% level.

**6.General Dry Weight (g):** From Table 6, under normal soil conditions; In terms of the general dry weight of the plant (g), a statistical difference of 0.05 was found among the varieties examined. A statistically significant difference of 0.01 level was found in terms of the organic and chemical fertilizers used. In addition, a difference of 0.01 level was found statistically in terms of variety \* fertilizer interaction. In terms of varieties grown under normal soil conditions, the lowest overall dry weight (g) value was obtained from 2.44 (Lima) variety and the highest overall dry weight (g) value was obtained from 3.11 (Candia) variety. The general dry weight (g) values of the plants belonging to the Candia variety were found to be higher. Differences in general dry weight (g) between varieties is a genetic feature. In terms of used fertilizers, the lowest general dry weight (g) value was obtained from 2.48 (cattle manure) application and the highest general dry weight (g) value was obtained from 3.13 (worm manure) application. In terms of variety \* fertilizer interaction, the lowest general dry weight (g) value was obtained from the application of 1.90 (lima variety \* cattle manure) and the highest general dry weight (g) value of 3.55 (candia variety \* control). There was no statistically significant difference between cotton varieties grown in salty soil conditions. The differences among the used fertilizers was statistically significant at 0.01 level and in terms variety \* fertilizer interactions were obtained statistically significant at the level of 0.01. In terms of the fertilizers used, the lowest general dry weight (g) value was obtained from the application of 1.93 (worm manure) and the highest general dry weight (g) value from 2.38 (DAP fertilizer) application. In terms of variety \* fertilizer interaction, the lowest general dry weight (g) value was obtained from 1.83 (lima variety \* worm manure) application and the highest general dry weight (g) value was obtained from 2.46 (lima variety \* DAP fertilizer interaction) application. Turan, (2000); Revathı & Arumugam, (2015); Soares et al. (2018). The results from their studies conducted that as salt concentrations in the soil increase, plant dry weight decrease are similar to our findings. Our findings are created a similarity with the findings of Soyergin (2003) that barn manure applied the soil is affected the net mineralization (C/N) rate and that organic fertilizers provide a suitable environment for soil fertility by increasing the soil organic matter levels in the long term as well as the supply of nutrients for the short and medium term. Our findings are consistent with the finding of Abdel-Aziz (2019) that fertilization methods are increased the dry weight of the plant in a study they conducted to determine the effects of humic acid and bacillus bacteria on some physiological and productivity properties of a cotton variety. Our findings are similar to the findings of Avcı et al. (2020) that the effects of salt applications on plant dry weight are examined, a decrease in plant dry weight was observed with increasing salt concentration.

Table 6. The Effects of Fertilizers Applied in Normal and Salty Soil Conditions on General Dry Weight (g), Values Obtained and Groups of Variability Coefficients (CV%) Based on LSD Test

|  |  |  |  |
| --- | --- | --- | --- |
| Investigated Features | Fertilizers Application | Normal Soil | Salty Soil |
| Varieties | Varieties |
| Candia | Lima | means | Candia | Lima | means |
| 6. General Dry Weight (g) | 1.DAP | 2.76c | 2.67c | 2.71 | 2.30b | 2.46a | 2.38 |
| 2. Cattle manure | 3.07b | 1.90d | 2.48 |  |  |  |
| 3. Worm Manure | 3.09b | 3.17b | 3.13 | 2.02c | 1.83d | 1.93 |
| 4.Control | 3.55a | 2.02d | 2.78 |  |  |  |
| Meanz | 3.11 | 2.44 | 2.77 | 2.16 | 2.15 | 2.15 |
| CV(%), LSD | CV(%):4.92 LSD (Çeşit):0.38\* LSD(Gübre):0.17\*\* LSD (Çeşit x Gübre):0.24\*\* | CV(%):1.92 LSD (Çeşit):n.s. LSD (Gübre):0.05\*\* LSD (Çeşit x Gübre):0.05\*\* |

There is no significant difference between the averages in the same letter group compared to LSD (5%). n.s:no significant. \*: Important at the 5% level; \*\*: Important at 1% level.

**7. Root Dry Weight (g):** From Table 7; under normal soil conditions; In terms of root dry weight (g) of the plant, a statistically significant difference of 0.05 was found between the cultivars. A statistically significant difference of 0.01 level was found in terms of the organic and chemical fertilizers used. In addition, a statistical difference of 0.01 level was found in terms of variety \* fertilizer interaction. In terms of the varieties used in normal soil conditions, the lowest root dry weight (g) value was obtained from 0.46 (Lima) variety and the highest root dry weight (g) value was obtained from 0.59 (Candia) variety. Root dry weight (g) of plants belonging to Candia variety was higher. The difference in root dry weight between varieties is a genetic feature. In addition, environmental and cultural factors may have an effect on this difference. In terms of the fertilizers used, the lowest root dry weight (g) value was obtained from 0.47 (cattle manure) application and the highest dry weight (g) value was obtained from 0.59 (worm manure) application. In the parcels where worm fertilizer was applied under normal soil conditions, root dry weight was the highest with 0.59 g. In terms of variety \* fertilizer interaction, the lowest root dry weight (g) value was obtained from 0.36 (Lima variety \* bovine manure) application and the highest root dry weight (g) value was obtained from 0.67 (candia \* control) application. In terms of variety \* fertilizer interaction, the lowest root dry weight (g) value was obtained from 0.36 (Lima variety \* cattle manure) application and the highest root dry weight (g) value was obtained from 0.67 (candia \* control) application. There was no statistically significant difference between the cotton varieties examined in terms of root dry weight (g) of the plant in salty conditions, but statistically a difference of 0.01 level was found in terms of the fertilizers used. In addition, a statistically significant difference of 0.05 was found in terms of variety \* fertilizer interaction. In terms of the fertilizers used, the lowest root dry weight (g) value was obtained from 0.37 (DAP chemical fertilizer) application and the highest root dry weight (g) value was obtained from 0.45 (worm fertilizer) application. In terms of the fertilizers applied, the worm manure application was the highest with 0.45 g. In terms of variety \* fertilizer interaction, the lowest root dry weight (g) value was obtained from 0.35 (Lima variety \* worm manure) application and the highest root dry weight (g) value was obtained from 0.46 (Candia variety \* DAP fertilizer application. Stating that salt density negatively affects root growth and weight; Reinhardt & Rost, (1995a); Reinhardt & Rost, (1995b); Raia & Azimov, (1988); Meloni et al. (2001); Ashraf & Ahmad, (2000); The findings of Munns, (2002) were found similar to our findings.

Table 7. The Effects of Fertilizers Applied in Normal and Salty Soil Conditions on Root Dry Weight(g), Values Obtained and Groups of Variability Coefficients (CV%) Based on LSD Test

|  |  |  |  |
| --- | --- | --- | --- |
| Investigated Features | Fertilizers Application | Normal Soil | Salty Soil |
| Varieties | Varieties |
| Candia | Lima | means | Candia | Lima | means |
| 7.Root Dry Weight (g) | 1.DAP | 0.52c | 0.50c | 0.51 | 0.46a | 0.45b | 0.45 |
| 2 Cattle manure | 0.58b | 0.36d | 0.47 |  |  |  |
| 3. Worm Manure | 0.58b | 0.60b | 0.59 | 0.39c | 0.35d | 0.37 |
| 4.Control | 0.67a | 0.38d | 0.53 |  |  |  |
| Meanz | 0.59 | 0.46 | 0.52 | 0.42 | 0.40 | 0.41 |
| CV(%), LSD | CV(%):5.01 LSD (Çeşit):0.043\* LSD (Gübre):0.02\*\* LSD (Çeşit x Gübre):0.04\*\* | CV(%):0.98 LSD (Çeşit):n.s. LSD (Gübre):0.22\*\* LSD (Çeşit x Gübre):0.19\* |

There is no significant difference between the averages in the same letter group compared to LSD (5%). n.s:no significant. \*: Important at the 5% level; \*\*: Important at 1% level.

**Conclusion**

The highest total chlorophyll value is from the DAP (chemical) fertilizer application; The highest plant height value is from cattle manure application; The highest plant root height value was found in DAP (Chemical) fertilizer application. There was no statistical difference among the used fertilizers in terms of the highest general wet weight value. The highest root wet weight value was obtained from Candia variety and Worm fertilizer application; The highest general dry weight value is from Candia variety and Worm fertilizer application; The highest root dry weight value was obtained from Candia variety and Worm fertilizer application. In the research conducted under normal soil conditions, it was concluded that the highest value was obtained from Candia variety and Worm fertilizer application in terms of the properties examined in general. In salty soil conditions, plant germination and development were achieved only in DAP (chemical) fertilizer and Worm fertilizer applications. Observations and measurements were made in accordance with this development. The highest total chlorophyll value from worm manure application; The highest plant height value was obtained from the cattle manure application. There was no difference between the fertilizers used in terms of plant root length. The highest general wet weight value, the highest root wet weight value, and the highest overall dry weight value were obtained from the DAP (chemical) fertilizer application. The highest root dry weight value was obtained from the application of worm manure. In the research conducted in salty soil conditions, it was concluded that the highest values were obtained from the application of DAP (chemical) fertilizer in terms of the properties examined in general. According to the research, it was concluded that the values obtained in saline soil conditions in terms of all the properties examined were lower than the normal soil conditions. It was concluded that salty soil conditions are negative in terms of germination, physiological development and product yield of the plant.

**References**

AbdEl-Aziz, M., W. Y. Adla and A.M. Ibrahim. 2019. Effect of organic and bio fertilizers on some growth and productivity traits of cotton line 124 (Gossypium hirsutum L.).

Allakhverdiev, S. I., A. Sakamoto, Y. Nishiyama, M. Inaba and N. Murata. 2000. Ionic and osmotic effects of NaCl-induced inactivation of photosystems I and II in Synechococcus sp. *Plant physiology*, *123*(3), 1047-1056.

Amjad, J., M. Yasin, G. Nabi and A. Rauf. 2002. Evaluation of germination and growth of cotton by presowing treatments under salt-stressed conditions. *Pakistan Journal of Agricultural Research*, *17*(2), 170-175.

Anonimous, 2020, TÜİK, 2020. Import-Export TÜİK January-September Period.

Alamgir, A. N. M. and M. Y. Ali. 1999. Effect of salinity on leaf pigments, sugar and protein concentrations and chloroplast ATPase activity of rice (Oryza sativa L.). *Bangladesh Journal of Botany*, *28*(2), 145-149.

Ashraf, M. and S. Ahmad. 2000. Influence of sodium chloride on ion accumulation, yield components and fibre characteristics in salt-tolerant and salt-sensitive lines of cotton (Gossypium hirsutum L.). *Field Crops Research*, *66*(2), 115-127.

Ashraf, M. 2004. Some important physiological selection criteria for salt tolerance in plants. *Flora-Morphology, Distribution, Functional Ecology of Plants*, *199*(5), 361-376.

Avcı, U. Y. H. A. A. Ahmed, S. Uranbey and G. Akdoğan. 2020. Farklı Pamuk Çeşitlerinin İn Vitro Koşullarda Tuz Stresine Toleransının Belirlenmesi. *Gaziosmanpaşa Bilimsel Araştırma Dergisi*, *9*(1), 13-26.

Barrick, B., R. Steiner, G. Picchioni, A. Ulery and J. Zhang. 2015. Salinity responses of selected introgressed cotton lines grown in two soils from organic and conventional cotton production. *J Cotton Sci*, *19*, 268-278.

Basal, H. P. J. B. 2010. Response of cotton (Gossypium hirsutum L.) genotypes to salt stress. *Pak. J. Bot*, *42*(1), 505-511.

Bhagwat, M. A., B. K. Rajkumar, P. R. Parmar and H. R. Ramani. 2020. Physiological characterization of cotton genotypes (Gossypium herbaceum L.) for salinity at seedling stage. *IJCS*, *8*(2), 2306-2312.

Carter, D. L. 1975. Problems of salinity in agriculture. In *Plants in saline environments* (pp. 25-35). Springer, Berlin, Heidelberg.

Castillo, N. and J. Dever. 2011. *A hydroponic approach to evaluate responses to salinity stress in cotton* (Doctoral dissertation, Ph. D. Dissertation. Texas Tech University, Lubbock, TX).

Casenave, E. C., C.A. Degano, M.E. Tosellı and E.A. Catan, 1999. Statistical studies on anatomical modifications in the radicle and hypocotyl of cotton induced by NaCl. *Biological Research*, *32*(4), 289-295.

De Villiers, A. J., M.W. Van Rooyen, G. K. Theron and H.A. Van De Venter. 1994. Germination of three Namaqualand pioneer species, as influenced by salinity, temperature and light. *Seed Science and Technology*, *22*(3), 427-433.

Doğru, A. and S. Canavar. 2019. Bitkilerde Tuz Toleransının Fizyolojik ve Biyokimyasal Bileşenleri. *Aka demik Platform Mühendislik ve Fen Bilimleri Dergisi*, *8*(1), 155-174.

Epstein, E. 1980. Responses of plants to saline environments. In *Genetic engineering of osmoregulation* (pp. 7-21). Springer, Boston, MA.

Erdal, Ü., Ö. Sökmen, S. Göçmez, L. Bilir, K. Üner, N. Okur, B. Okur, D. Anaç, R. Ongun, A. Ertem and R. Çakmak. 2013. Pamuk Yetiştiriciliğinde Organik ve Konvansiyonel Tarım Uygulamalarının Verim, Kalite ve Toprak Özellikleri Üzerine Etkileri. Uluslararası Tarımsal Araştırma ve Eğitim Merkezi, İzmir, S:1-20.

Ergene, A. 1982. Toprak Bilgisi. Atatürk Üniversitesi Ziraat Fakültesi Yayınları. No:267, Ders Kitapları Serisi No: 42, Erzurum.

Flowers, T. J. and S. A. Flowers. 2005. Why does salinity pose such a difficult problem for plant breeders?. *Agricultural Water Management*, *78*(1), 15-24.

Flowers, T. J. and T. D. Colmer. 2008. Salinity tolerance in halophytes. *New Phytologist*, 945-963.

Fujikura, Y., H.L. Kraak, A.S. Basra and C.M. Karssen. 1993. Seed and Technology. 21, 639-642.

Gorham, J. 1996. Mechanism of salt tolerance of halophytes. *Halophytes and biosaline agriculture*, 207-223.

Hemphill, J.K., H. Basal, and W.C. Smith. 2006. Screening method for salt tolerance in cotton. Am. J. Plant Pathol. 1:107-112.

Jackson, L.E., K.L. Calderon, K.M. Steenwerth, K.M. Scow and Roltson, D.E., 2003. Responses of soil microbial processes and community structure to tillage events and implications for soil quality. Geoderma, 114:305-317.

Jafri, A. Z. and R. A. F. I. Q. Ahmad. 1994. Plant growth and ionic distribution in cotton (Gossypium hirsutum L.) under saline environment. *Pakistan Journal of Botany*, *26*, 105-105.

Kennedy, B., L.F. De Filippis. 1999. Physiological and oxidative response to NaCl of the salt tolerant Grevillea ilicifolia and the salt sensitive Grevillea arenaria. *Journal of plant physiology*, *155*(6), 746-754.

Khalıq, A., M.K. Abbasi, and T. Hussaın. 2006. Effects of integrated use of organic and inorganic nutrient sources with effective microorganisms (EM) on seed cotton yield in Pakistan. Bioresource Technology. 97(8): 967-972.

Khavari-Nejad, R. A., and Y. Mostofi. 1998. Effects of NaCl on photosynthetic pigments, saccharides, and chloroplast ultrastructure in leaves of tomato cultivars. *Photosynthetica*, *35*(1), 151-154.

Khenifi, M. L., M. Boudjeniba and A. Kameli. 2011. Effects of salt stress on micropropagation of potato (Solanum tuberosum L.). *African Journal of Biotechnology*, *10*(40), 7840-7845.

Kwiatowski, J. 1998. Salinity classification, mapping and management in Alberta. *İnternetten alınan bilgi: http://www. bahce. biz/toprak/tuzluluk. htm (Erişim Tarihi: 05.06. 2006)*.

Maxwell, K. and G. N. Johnson. 2000. Chlorophyll fluorescence—a practical guide. *Journal of experimental botany*, *51*(345), 659-668.

Meloni, D. A., M. A. Oliva, H. A. Ruiz and C. A. Martinez. 2001. Contribution of proline and inorganic solutes to osmotic adjustment in cotton under salt stress. *Journal of Plant Nutrition*, *24*(3), 599-612.

Mitsuya, S., Y. Takeoka and H. Miyake. 2000. Effects of sodium chloride on foliar ultrastructure of sweet potato (Ipomoea batatas Lam.) plantlets grown under light and dark conditions in vitro. *Journal of plant physiology*, *157*(6), 661-667.

Mittler, R. 2006. Abiotic stress, the field environment and stress combination. *Trends in plant science*, *11*(1), 15-19.

Munns, R. 2002. Comparative physiology of salt and water stress. *Plant, cell & environment*, *25*(2), 239-250.

Munns, R. and M. Tester. 2008. Mechanisms of salinity tolerance. *Annu. Rev. Plant Biol.*, *59*, 651-681.

Neumann, P. 1997. Salinity resistance and plant growth revisited. *Plant, Cell & Environment*, *20*(9), 1193-1198.

Vamadevaiah, H. M. 2011. *In Vitro Screening for Salt Tolerance in Cotton* (Doctoral dissertation, UAS, Dharwad).

Pessarakli, M., and T. C. Tucker. 1985. Uptake of nitrogen‐15 by cotton under salt stress. *Soil Science Society of America Journal*, *49*(1), 149-152.

Pitman, M. G. and A. Läuchli. 2002. Global impact of salinity and agricultural ecosystems. *Salinity: environment-plants-molecules*, *3*, 20.

Phogat, V., S. Satyawan, S. Kumar, S.K. Sharma, A.K. Kapoor and M.S. Kuhad. 2001. Performance of upland cotton (Gossypium hirsutum) and wheat (Triticum aestivum) genotypes under different salinity conditions. *The Indian Journal of Agricultural Sciences*, *71*(5).

Qadir, M. and M. Shams. 1997. Some agronomic and physiological aspects of salt tolerance in cotton (Gossypium hirsutum L.). *Journal of Agronomy and Crop Science*, *179*(2), 101-106.

Raia, N. A. and R. A. Azimov. 1988. Effect of NaCl solutions on germination and seedling growth. *Uzbek. Biol. J*, *2*, 22-24.

Reddy, K. R., V. G. Kakanl, D. Zhao, S. Kotl and Gao, W. 2004. Interactive Effects of Ultraviolet‐B Radiation and Temperature on Cotton Physiology, Growth, Development and Hyperspectral Reflectance. *Photochemistry and Photobiology*, *79*(5), 416-427.

Reinhardt, D. H. and T. L. Rost. 1995a. Developmental changes of cotton root primary tissues induced by salinity. *International Journal of Plant Sciences*, *156*(4), 505-513.

Reinhardt, D. H. and T. L. Rost. 1995b. On the correlation of primary root growth and tracheary element size and distance from the tip in cotton seedlings grown under salinity. *Environmental and Experimental Botany*, *35*(4), 575-588.

Revathı, S. and P.M. Arumugam. 2015. *In vitro* screening for salt tolerance in rice (*Oryza Satıva* L.). Asian Journal Of Microbiol Biotech, 17(Spl. Iss.) 91-95.

Ahmad, S., M. Z. Iqbal, A. Hussain and M. Hassan. 2002. Salt tolerance of cotton (Gossypium hirsutum L.). *Asian Journal of Plant Sciences*.

Salvucci, M. E. and and S. J. Crafts‐Brandner. 2004. Inhibition of photosynthesis by heat stress: the activation state of Rubisco as a limiting factor in photosynthesis. *Physiologia plantarum*, *120*(2), 179-186.

Sharma, S. K. and S. S. Goyal. 2003. Progress in plant salinity resistance research: need for an integrative paradigm. *Journal of crop production*, *7*(1-2), 387-407.

Shankar, A. and R. K. Gupta. 2020. Site-specific fertilizer nitrogen management in Bt cotton using chlorophyll meter. *Experimental Agriculture*, 1-10.

Soares, L. A. D. A., P. D. Fernandes, G. S. D. Lima, J. F. Suassuna, M. E. Brito and F. V. D. S. Sá. 2018. Growth and fiber quality of colored cotton under salinity management strategies. *Revista Brasileira de Engenharia Agrícola e Ambiental*, *22*(5), 332-337.

Soyergin, S. 2003. Organik Tarımda Toprak Verimliliğinin Korunması, Gübreler Ve Organik Toprak İyileştiricileri.

Szabolcs, I. 1994. Soils and salinization. P.11-13. In M. Pessarakli (ed.) Handbook of Plant and Crop Stres. Marcel Dekker, New York.

Taghipour, F. and M. Salehi. 2009. The study of salt tolerance of Iranian barley (Hordeum vulgare L.) genotypes in seedling growth stages. *Indian Journal of Crop Science*, *4*(1and2), 117-120.

Turan, M. and S. Özcan. 2000. Türkiye’de kültürü yapılan bazı patates çeşitlerinin in vitro’da tuza dayanıklılığının belirlenmesi üzerine araştırmalar. *AÜ ZF Tarla Bitkileri Ana Bilim Dalı Doktora Tezi, 123s, Ankara*.

Woods, S. A. 1996. Salinity tolerance of ornamental trees and shrubs. *Food and Rual Development and Agriculture and Agrifood. Canada*.

Zhu, J. K. 2001. Plant salt tolerance. *Trends in plant science*, *6*(2), 66-71.