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ORIGINAL PAPER

Effects of mycorrhiza, seaweed and bionutrient applied to reduce the salt stress on nutrient content, plant growth, malondialdehyde (MDA) and proline in pepper

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Abstract

Pepper *(Capsicum annuum* L.) is an important vegetable crop in Turkey; at the same time, salinity is a big problem in some areas of Turkey. The experiment was conducted in a greenhouse at the Silifke Vocational School of Mersin University, in March 2022. The pepper cultivar Arena F1 was used as plant material. Mycorrhiza (Endo Roots Soluble-ERS), seaweed and bionutrient (PGPR) were applied to pepper plants. Pepper seedlings were kept for 2 minutes in water with mycorrhiza (3 g L^{-1}), seaweed (3 mL L^{-1}) or bionutrient (3 g L^{-1}), prepared in separate containers, and then were planted in pots in a greenhouse. After planting, 200 mL was applied to each seedling to the soil twice at a one-week interval. The plants were subjected to NaCl (150 mM) for 20 days during early seedling growth. In this study, it has been determined that the treatments with mycorrhiza, seaweed and bionutrient have a positive effect on plant growth, fresh weight (FW), dry weight (DW), leaf number, plant height and root length, and amount of nitrogen (N), phosphorus (P), potassium (K), calsium (Ca), and magnesium (Mg) in pepper plants under salt stress. MDA, proline and Na contents of pepper plants increased under salt stress, but these parameters decreased owing to the alleviation of adverse effects of salt stress by using mycorrhiza, seaweed and bionutrients, resulting in the plants' increased tolerance to salt stress.

Keywords: pepper, organic fertilizer, mineral composition, plant growth, salinity stress, MDA and proline

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INTRODUCTION

In 2022, vegetable production reached about 31 million tons of all vegetables, and the pepper production accounted for about 2.63 million tons in Turkey (TUIK 2022). The United Nations Environment Program estimates that 20% of the world's agricultural land and 50% of the fertile land face the problem of salinity (Flowers, Yeo 1995). In Turkey, there are about 1.5 million hectares of farmland lying in salinity problem areas, of which 32.5% can be irrigated (Yılmaz et al. 2011).

According to Mahajan and Tuteja (2005), effects of biotic and abiotic stress factors are seen in plants. While drought and salinity are known as abiotic stress factors, viruses, bacteria and fungi are defined as biotic stress factors. One of the most important stress factors affecting agricultural lands is drought (26%); another significant factor is mineral stress, which is an abiotic stress (Blum 1986), and salinity constitutes a large part of mineral stress (Tuteja 2007). In studies, it has been reported that plants experience stress in three different ways due to the physiological drought, ion toxicity as a result of the increase of Na^+ and Cl^- ions in the root zone, and imbalances in the intake and transportation of nutrients (Munns, Termaat 1986, Marschner 1995). A high salt level in the soil causes osmotic and specific ion effects that lead to oxidative stress in plants. As a result, there are negative influences on germination, growth and reproduction as well as decreased yield (Chinnusamy et al. 2005).

Plant length, stem and root fresh and dry weights, stem diameter and macroelement content in leaves were positively affected by the addition of organic and inorganic substances to the environment in which pepper plants grew under salt stress (Tuna, Eroglu 2017). It was reported that the growth and development of peppers grown under salt stress were negatively affected and as a result of this, plant fresh and dry weight, yield, root and stem length decreased (Greenway, Munns 1980, Kaya et al. 2001).

Some bacteria are known as beneficial bacteria and they have been reported to support plant growth and improve salt tolerance in some plants (Forni et al.2017, Bharti, Barnawal 2019). In a study on pepper, arbuscular mycorrizal fungi (AMF) reduced salt stress by preventing Na^+ from being taken in excess and at the same time increasing peroxidase and catalase enzyme activity. El-Sarkassy et al. (2017) reported that it was possible to reduce the harmful effects of salinity stress with the application of humic acid and mycorrhiza. AMF promotes more efficient uptake of nutrients by improving soil properties and positively affecting root development, thus promoting better growth of plants (Wu et al. 2010, Hameed et al. 2014, Hodge, Storer 2015). In a study conducted on beans, it was reported that worm manure positively affected plant growth under salt stress (Beykkhormizi et al. 2016).

Proline accumulation occurs in most plants as a physiological response to stress conditions (such as drought, salt, nutrient deficiency, high and low temperature, etc.) and increases with stress intensity (Hare, Cress1997, Siripornadulsil et al. 2002).

The aim of this study has been to investigate the growth of pepper plant under salt stress by using some biofertilizers. By choosing these fertilizers, a distinct advantage will be created in that that they can be used especially in organic farming.

MATERIALS AND METHODS

This study was carried out at the Silifke Vocational School of Mersin University Research and Application Greenhouses, in March 2022. The Arena F1 pepper variety was used as plant material. The peppers were planted in 2-liter pots and the salt stress application was started when they had 5-6 true leaves. NaCl (150 mM) was applied for 20 days, after which the plants were harvested. The experiment was set up in a completely randomized design with 4 replications and 10 plants per repetition. Pepper seedlings were kept in water with mycorrhiza (3 g L^{-1}) from Bioglobal Company, seaweed (3 mL L^{-1}) from Algia Techno made by Antstar company, and bionutrient PGPR (3 g L^{-1}) from Hekagro Company, all aplied to seedlings in separate containers for 2 minutes, after which the seedlings were planted in pots and kept in a greenhouse. Then, 200 mL was applied to each seedling to the soil twice at a one-week interval.

Growth parameters and leaf nutrient analysis

After the plants were harvested, the shoots and roots were washed and fresh weight was measured. Then, the plant shoots and roots, whose fresh weights were taken, were dried in an oven at 65°C for 48 h and then their dry weights were taken (Yarsi et al. 2017). The main plant height and root lengths were measured with a ruler, and the main stem diameter was measured with a digital caliper. P was determined by the vanadate-molybdate method and N was analyzed by the Kjeldahl digestion method (Westerman 1990). Ca^{2+}, Mg^{2+}, K^+ and Na^+ were determined according to Nouck et al. (2021).

Malondialdehyde (MDA) and proline content

The MDA content was analyzed according to Ohkawa, Ohishi, Yagi (1979), and the proline content was measured on an Analytic Jena Specord 210 plus spectrophotometer according to Bates et al. (1973).

Statistical analysis

SPSS software version 13.0 (SPSS, Inc., USA) was used for statistical analysis and variance analysis, followed by the Duncan's multiple range test at a 95% confidence level.

RESULTS

Plants in the salt-free group (-NaCl) were considered as controls of the salt--treated (+NaCl) groups. Changes in the measured parameters were evaluated by comparing each application with the control. In both experimental and control treatments, there were decreases in plant height, stem diameter, root length and leaf number at varying rates under salt stress. Considering the effect of salt stress on plant height, the decrease was the highest (49.8%) in control and the lowest (26.9%) in the mycorrhiza treatment, compared to 36.4% in the seaweed treatment and 36.5% in the bionutrient treatment. Salt stress caused reductions of varying degrees in the size of the shoots. However, the highest decrease was in control plants at 30.8%, while the lowest decrease was in plants treatment with mycorrhiza, where it equalled 12.7%. It was 13.6% in both seaweed- and bionutrient-treated plants.

The effect of salt stress on the root length of pepper was also important. Control plants had the smallest root length in both salt stress and non-salt stress applications, while plants treated with mycorrhiza had the longest roots. Salt stress also negatively affected the number of leaves. However, control plants were most severely affected. While the decrease in the number of leaves was 49.2% in the control, it reached 32.1%, 36.0% and 36.9% in mycorrhiza, seaweed and bionutrient treatments, respectively. Although there was a decrease in the number of flowers and fruit on the plants exposed to salt stress, this decrease was much higher in control plants than in the other variants. The application of mycorrhiza, seaweed fertilizer and bionutrient reduced the negative effect of salt stress and caused lesser effect on the flowering and fruit setting of plants. In the control plants, salt stress reduced the blooming by 46.2% and fruit setting by 66.5%. The parallel decreases were 13.0% and 30.0% in plants inoculated with mycorrhiza; 13.6% and 25.1% in seaweed application; and 18.1% and 12.7% in plants given bionutrient (Table 1).

Considering the total fresh and dry weights of plants, it was determined that the effect of the applied substances on both fresh and dry weight was statistically significant. It was determined that the application of mycorrhiza (-NaCl and + NaCl) in both groups caused an increase of 73.6% and 290.0% in the total fresh weight compared to the control, respectively. This increase caused by the seaweed application was 14.5% (-NaCl) and 123.9% (+NaCl); as for the application of bionutrient, the increase was determined as 40.4% and 161.1%. It was seen that there were similar differences in total dry

Table 1

Effects of mycorrhiza, seaweed and bionutrient on some parameters of pepper plants grown under salt stress

Applications		Plant height (cm)	Stem diameter (mm)	Root lenght (cm)	Number of the leaves	Number of the flowers	Number of the fruits
-NaCl	control	30.5±0.8^{d}	6.50±0.32^{c}	22.0±0.3^{d}	25.0±0.8^{c}	4.33±0.57^{c}	2.00±0.40^{b}
	mycorrhiza	52.5±0.8^{a}	8.26±0.34^{a}	28.2±0.4^{a}	34.3±0.7^{a}	7.67±0.74^{a}	3.33±1.00^{a}
	seaweed	38.5±1.1^{c}	7.65±0.99^{ab}	27.8±1.1^{a}	33.0±0.6^{ab}	7.33±0.57^{ab}	2.67±0.57^{ab}
	bionutrient	43.6±1.2^{b}	7.78±0.59^{ab}	25.6±0.9^{b}	31.7±0.4^{b}	7.33±0.57^{ab}	2.67±0.47^{ab}
+NaCl	control	15.3±0.5^{g}	4.45±0.25^{d}	15.4±0.3^{f}	12.7±0.3^{f}	2.33±1.00^{d}	0.67±0.67^{c}
	mycorrhiza	30.1±0.4^{de}	7.21±0.33^{bc}	24.0±0.1^{c}	23.3±0.4^{cd}	6.67±0.57^{ab}	2.33±0.57^{ab}
	seaweed	24.5± 0.4^{f}	6.61±0.42^{c}	21.8±0.2^{d}	21.3±0.3^{de}	6.33±0.62^{b}	2.00±0.00^{b}
	bionutrient	28.7± 0.9^{e}	6.72±0.47^{c}	20.2±1.1^{e}	19.5±0.2^{e}	6.50±1.00^{ab}	2.33±0.57^{ab}

Values denoted with same letters are not significantly different according to the Duncan's test at a $p<0.05$.

weight. In the mycorrhiza application, it was determined to be higher by 132.4% (-NaCl) and 362.3% (+NaCl) compared to the control, while increasing by 66.2% and 222.2% following the seaweed application; in the bionutrient treatment, this parametter rose by 102.2% and 318.8% relative to the control (Table 2).

Table 3 shows the content of nutrients in pepper plantrs. The content of nitrogen (N) was determined to be 2.66 mg g^{-1} dry weight in the control

Table 2

Effects of mycorrhiza, seaweed and bionutrient on total fresh and dry weight of pepper plants grown under salt stress

Applications		Total fresh weight (g)	Increasing compared to control (%)	Total dry weight (g)	Increasing compared to control (%)
-NaCl	control	37.46±0.64^{d}	-	3.05±0.01^{g}	-
	mycorrhiza	65.05±0.74^{a}	73.6	7.09±0.18^{a}	132.4
	seaweed	42.90±0.75^{c}	14.5	5.07±0.15^{d}	66.2
	bionutrient	52.63±0.70^{b}	40.4	6.17±0.08^{b}	102.2
+NaCl	control	13.49±1.08^{f}	-	1.17±0.10^{h}	-
	mycorrhiza	52.62±0.56^{b}	290.0	5.41±0.06^{c}	362.3
	seaweed	30.21±0.64^{e}	123.9	3.77±0.18^{f}	222.2
	bionutrient	35.23±0.96^{d}	161.1	4.90±0.14^{e}	318.8

Values denoted with same letters are not significantly different according to the Duncan's test at a $p<0.05$.

Table 3

The effects of mycorrhiza, seaweed and bionutrient on the nutrient content (N, P, K, Ca, Mg) of pepper plants grown under salt stress (mg g^{-1} d.w.)

Applications		N	P	K	Ca	Mg
-NaCl	control	2.66±0.06^{e}	0.18±0.20^{f}	36.57±0.30^{d}	15,17±0.25^{c}	11.13±0.15^{b}
	mycorrhiza	3.31±0.03^{a}	0.32±0.15^{a}	41.17±0.25^{a}	17.27±0.15^{a}	12.00±0.25^{a}
	seaweed	3.08±0.03^{b}	0.24±0.37^{de}	38.40±0.55^{c}	16.86±0.20^{b}	12.30±0.10^{a}
	bionutrient	3.26±0.04^{a}	0.30±0.10^{b}	40.03±0.31^{b}	16.77±0.18^{b}	12.33±0.06^{a}
+NaCl	control	2.21±0.01^{f}	0.11±0.26^{g}	13.97±0.21^{h}	7.98±0.19^{f}	5.63±0.21^{f}
	mycorrhiza	3.01±0.03^{b}	0.28±0.30^{bc}	27.83±0.37^{e}	11.44±0.16^{d}	8.03±0.23^{e}
	seaweed	2.84±0.04^{d}	0.20±0.25^{e}	24.27±0.25^{g}	10.38±0.15^{e}	8.75±0.15^{d}
	bionutrient	2.94±0.03^{c}	0.26±0.10^{cd}	27.05±0.37^{f}	11.29±0.08^{d}	9.67±0.15^{c}

Values denoted with same letters are not significantly different according to the Duncan's test at a $p<0.05$.

plants grown without salt stress, while decreasing to 2.21 mg g^{-1} d.w. in plants exposed to salt stress. Thus, a 16.9% reduction in nitrogen was induced in control plants by salt stress. This decrease was 7.8% in seaweed-treated plants, 9.1% and 9.8% when mycorrhiza or bionutrient had been applied. It has been observed that the applied substances have a positive effect on the nitrogen uptake in peppers grown under salt stress. A similar situation was determined with respect to P uptake. The P content was the lowest (0.18 and 0.11 mg g^{-1}) in the control plants both in the salt-free and salt-treated groups, while a 38.9% reduction occurred due to salt application. This decrease was 12.5% in the mycorrhiza treatment, 13.3% in the bionutrient treatment, and 16.7% in the seaweed treatment.

The effect of different fertilizers on K, Ca and Mg uptake in pepper plants grown under salt stress was found to be statistically significant. It was observed that the applications of mycorrhiza, seaweed and bionutrients had positive effects on K, Ca and Mg uptake by reducing the negative effects of salt stress. In control plants under salt stress, there was a decrease of 61.7% in K uptake, 47.4% in Ca uptake and 49.4% in Mg uptake. This reduction was 32.4%, 33.8% and 33.08%, respectively, in the mycorrhiza variant. In the seaweed application, it was determined as 36.8%, 38.4% and 28.7%, respectively. The reduction which occurred in the bionutrient treatment as regards the uptake of these three elements was 32.4% for potassium, 32.7% for calcium and 21.6% for magnesium.

When the Na content was examined (Table 3), it was observed that the amount of Na in plants increased with the application of salt. This increase was 137.2% in control plants, 74.1% in the mycorrhiza application, 84.9% in the seaweed application and 76.1% in the bionutrient application. Mycorrhiza, seaweed and bionutrient applications in pepper plants grown under salt stress caused a decrease in the amount of Na in plant leaves compared to the control, whereas the amount of N, P, K, Ca and Mg increased at different rates compared to the control plants (Tables 3, 4).

The K^+ / Na^+ ratio decreased in salt applied plots compared to their controls. However, the greatest decrease was seen in plants that were not supplied any fertilizers. The fact that this ratio is high indicates that the plants take K^+ better under salt stress. According to this, the highest value was obtained (1.40 mg g^{-1} dry weight) in plants treated with mycorrhiza and exposed to salt stress. This was followed by plants exposed to salt stress in the seaweed treastment (1.37) and bionutrient treatment (1.31). The lowest value of this ratio (0.69) was determined in control plants without fertilizer application (Table 4).

When the Ca^{++}/Na^+ ratio was examined, it was determined that the lowest value was found in control plants which were not given any fertilization (0.28). This ratio was determined as 0.58 for the mycorrhiza application, 0.55 for the bionutrient application and 0.49 for the seaweed application. According to these results, it was determined that the plants took K^+ and Ca^{++} elements better than control plants with the application of mycorrhiza, seaweed or bionutrient to pepper plants grown under salt stress (Table 4).

Table 4

Effects of mycorrhiza, seaweed and bionutrient on the Na, $K^+/Na^+$and Ca^{++}/Na^+ ratios in pepper plant grown under salt stress (mg g^{-1} d.w.)

Applications		Na	K^+/Na^+	Ca^{++}/Na^+
-NaCl	control	12.10±0.20^{e}	3.02±0.02^{d}	1.25±0.04^{c}
	mycorrhiza	11.37±0.15^{f}	3.43±0.09^{a}	1.52±0.03^{a}
	seaweed	11.56±0.38^{f}	3.12±0.06^{c}	1.46±0.06^{b}
	bionutrient	11.70±0.10^{ef}	3.26±0.02^{b}	1.43±0.02^{b}
+NaCl	control	28.70±0.26^{a}	0.62±0.01^{h}	0.28±0.01^{f}
	mycorrhiza	19.80±0.30^{d}	1.40±0.04^{e}	0.58±0.02^{d}
	seaweed	21.37±0.25^{b}	1.37±0.02^{g}	0.49±0.01^{e}
	bionutrient	20.60±0.10^{c}	1.31±0.01^{f}	0.55±0.01^{d}

Values denoted with same letters are not significantly different according to the Duncan's test at a $p<0.05$.

MDA and proline

Considering the amount of MDA in the leaves, it was found to equal 0.088 (nmol g^{-1} FW) in control plants, while reaching 2.159 (nmol g^{-1} FW) in NaCl treated plants. It was determined as 1.991(nmol g^{-1} FW) in the mycorrhiza application, 1.893 (nmol g^{-1} FW) in the seaweed application, and 1.716 (nmol g^{-1} FW) in the bionutrient application. The effects of the organic fertilizers used on the amount of MDA were found to be statistically significant (Figure 1).

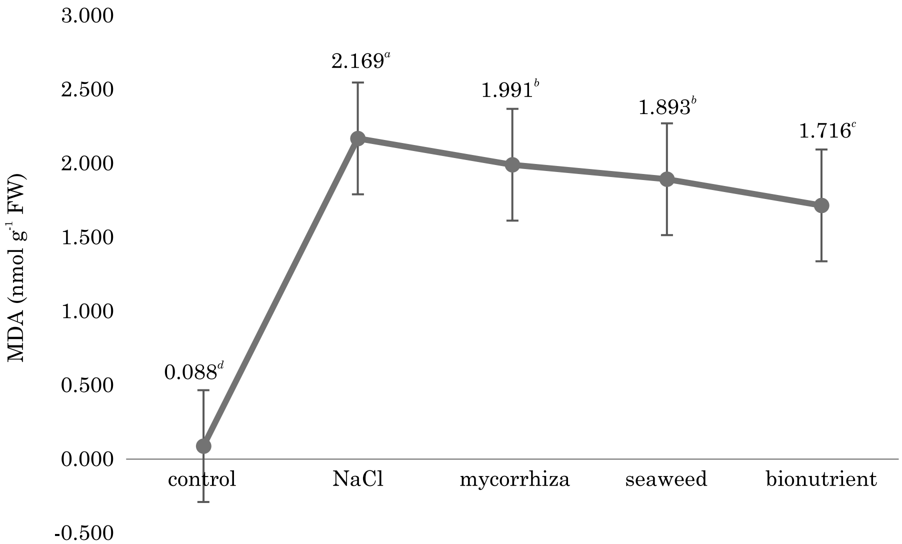

Fig. 1. The effects of mycorrhiza, seaweed and bionutrient applied to pepper plants on MDA in leaves under salt stress
Values denoted with same letters are not significantly different according to the Duncan's test at a $p<0.05$

Considering the amount of proline in the leaves, it was found to equal 3.407 (nmol g^{-1} FW) in control plants, while reaching 5.029 (nmol g^{-1} FW), which is the highest value in NaCl treated plants. When Figure 2 is examined, it emerges that the applied organic fertilizers reduced saline stress and there was a decrease in the amount of proline. The amount of proline, which was determined to equal 5.029 (nmol g^{-1} FW) in NaCl applied plants, was found to be 4.815 (nmol g^{-1} FW) in the mycorrhiza application, 4.742 (nmol g^{-1} FW) in the seaweed application, and 4.465 (nmol g^{-1} FW) in the bionutrient application, with the differences being statistically significant (Figure 2).

DISCUSSION

In this study, it was determined that salt stress negatively affects pepper plant growth. Applications of mycorrhiza, seaweed and bionutrient increased tolerance to salt stress. Positive differences occurred when these substances were given to plants compared to control. It was determined that the application of mycorrhiza, seaweed and bionutrient to the pepper plant grown under salt stress has a positive effect on plant growth by providing a significant increase in both fresh and dry weights, leaf number, plant height and root length. Studies have also reported that mycorrhizae positively affect plant growth under salt stress and increase plant growth (Tain et al. 2004, Zandavalli et al. 2004). In a study conducted on pumpkins grown

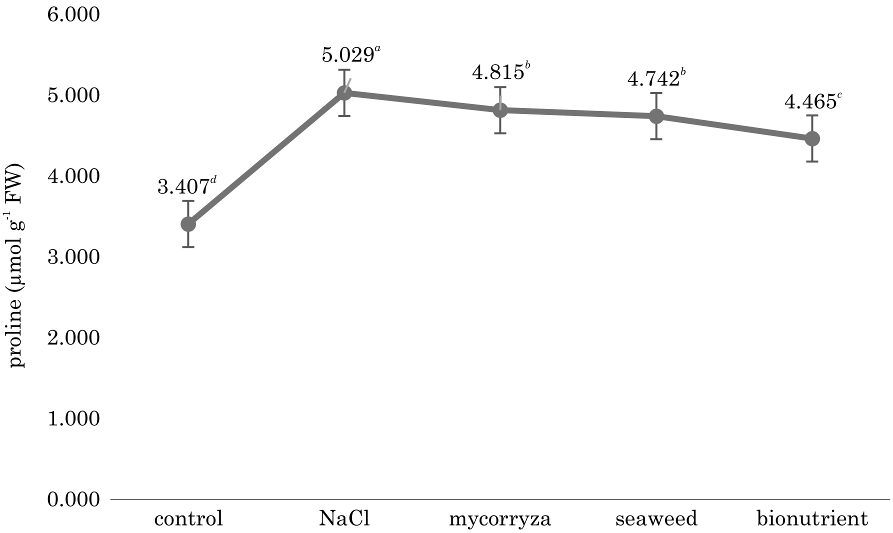

Fig. 2. The effects of mycoryzza, seaweed and bionutrient applied to pepper plants on leaf proline under salt stress. Values denoted with same letters are not significantly different according to the Duncan's test at a p<0.05

under salt stress, it was reported that seaweed extract increased the tolerance of plants to salt stress and thus positively affected the biomas and fruit quality of the plants (Hand et al. 2017, Rouphael et al. 2017).

In this study, it was determined that the effect of salt stress was reduced with the use of mycorrhiza, seaweed and bionutrient fertilizers in peppers grown under salt stress, and the amounts of N, P, K, Ca and Mg in the leaves were found to be higher than in leaves of the control plants. These results are similar to the ones reported by some researchers (Kowalski et al. 1999, Turan et al. 2014).

Especially in plants treated with mycorrhiza, the beneficial effects are generally higher than in plants submitted to the other applications. When the decrease in the aforementioned nutrients in the presence of salt stress was compared with the controls of each application, it was determined that the biggest decrease occurred in plants without any fertilizer application. It can be said that the use of mycorrhiza, seaweed and bionutrient increases the tolerance of pepper plants against salt stress, supports root development, thus increasing water and nutrient intake. Thus, plants were less affected by salt stress and continued to grow better than plants that were not treated with any organic fertilizers. These results are consistent with studies conducted with mycorrhiza (Kayaet al. 2009, Kumar et al. 2010, Garg, Chandel 2011, Scharnag et al. 2018). At the same time, the use of these fertilizers increased the Mg uptake in peppers under salt stress compared to the plants that were not applied any of these substances at all. This increase may have contributed to a better plant biome by affecting positively photosynthesis owing to the presence of Mg in the structure of chlorophyll. It was reported in similar studies that with the increasing Mg uptake, the amount of chlorophyll in plants increases and, accordingly, photosynthesis increases and the growth of plants accelerates (Champrubi et al. 2012, Metwally, Abdelhameed 2018).

As a result of the application of mycorrhiza, seaweed and bionutrient fertilizers raising the tolerance to salt stress in peppers, the plants benefited from the water and nutrients in the soil more effectively. Thus, owing to the tolerance improved by the fertilizers in pepper plants under salt stress, the uptake of the Na element was reduced and the negative effects of the excess of this element on the plants was minimized. Colla et al. (2008) reported that in pepper plants irrigated with sea water, mycorrhiza inoculation increased tolerance to salt stress and prevented Na flow to the plant. The use of seaweed extract increases the efficiency of nutrient absorption in the soil by plants (Aziz et al. 2011), and it has the ability to increase stress tolerance by reducing the negative effect of stress in many plant species (Norrie, Keathley 2006, Eyras et al. 2008, Rayirath et al. 2009). In some studies with bacteria, it has been reported that the use of bacteria such as Azospirillum, Arthrobacter, Azotobacter, Bacillus, Burkholderia, Enterobacter, and Pseudomonas increases salt tolerance in many plant species (Forni et al. 2017, Bharti, Barnawal 2019).

Considering changes in the K^+/Na^+ and Ca^{++}/Na^+ ratios, it was determined that these ratios decreased under salt stress. However, the biggest decrease was in control plants: by 79.5% in the K+/Na+ ratio and 77.6% in the Ca^{++}/Na^+. This decrease was 59.2% and 61.8%, respectively, in the mycorrhiza application; 56.1% and 66.4% in the seaweed application; and finally 59.8% and 61.5% in the bionutrient application. When we compared the groups within themselves and with control plants and observed the change in the K^+/Na^+ and Ca++/Na+ ratios under salinity stress, the K^+/Na^+ ratio was 55.7% and the Ca^{++}/Na^+ ratio was 51.7% in the mycorrhizal application compared to the control plants; 54.7% and 42.9% in the seaweed application; and 52.7% and 49.1% in the bionutrient application, respectively. It was determined that the highest increase in these parameters in plants exposed to salinity stress was achieved through the application of mycorrhiza.

It was determined that the amounts of MDA and proline increased in plants under salt stress, but decreased following the use of organic fertilizers (mycorrhiza, seaweed and bionutrient). It has been observed that the fertilizers used in this context alleviate the salt stress in pepper and enable the plants to grow more comfortably. The results of this study are in agreement with the study of Tuna, Eroğlu (2016) on pepper. It is also in agreement with other studies dealing with changes in MDA and proline contents under stress conditions and the effects of applied chemicals (Dawood et al. 2014, Saleh et al. 2016, Hand et al. 2017, Hafez et al. 2019).

CONCLUSION

In this study, it was determined that salt stress had negative effects on pepper. Mycorrhiza, seaweed and bionutrient applications reduced the negative effects of NaCl compared to the control. Although plant growth parameters and nutrients in leaves (Ca, Mg, K, N and P) differed depending on the fertilizers used, it was observed that they were higher than in the control plants. According to this study, the negative effect of NaCl can be minimized by using mycorrhiza, bionutrients and seaweed under salt stress. With these applications, better quality growth of plants can be achieved. Proline and MDA contents are higher in plants under stress. In this study, it was determined that the amount of MDA and proline increased in plants exposed to salt stress compared to the control. However, it was determined that the extent of this increase was smaller following the application of mycorrhiza, seewad and bionutrient. In this context, the use of these substances in areas with salinity problems in soil or irrigation water will alleviate the negative effects of stress due to salinity. Thus, the yield losses will be minimized and the profitability obtained per unit area will increase, which means greater profits for the producers.

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