Effect of salinity on morphological and physiological activities Accumulation in Mustard Plant (Brassica nigra.)

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Abstract
Salinity is one of important stresses that limit agricultural production. Salinity is influence on the plant growth through effect on more physiologic and morphologic activities. For this purpose, an experiments were conducted to evaluate the effect of salinity due the sodium chloride on the amount of Potassium (P), Magnesium (M), Calcium (Ca) and Phosphorus (P) in mustard, at the farm of the Islamic Azad University of Mashhad Branch, Iran, in 2012. It was carried on the randomized complete block design with three replications. Desired test performed in the lysimeters. In this experiment was used 12 cylindrical polyethylene lysimeters and was applied four treatments with various degrees of water salinity: 0, 2, 4 and 6 ds/m (water wells) each one with 3 replications. Remarkable note that the above-mentioned treatments was conducted after the initial stage of growth, so that after planting (8-leaf stage) until germination and early growth were used well water for irrigation in all the 12 lysimeters. The results showed that increasing salinity levels was significantly reduced amount of potassium, magnesium, calcium and phosphorus.

Keywords: salinity stress, irrigation, potassium, calcium, phosphorus, mustard and magnesium.

Introduction
Efforts to improve crop performance under salinity have been elusive owing to its multigenic and quantitative nature (Vinocur and Altman, 2005). An approach for studying and manipulating salt toler- ance in crop plants could be the analysis of natural variability existing amongst various cultivars of a particular crop. Screening of available local/exotic cultivars of crop plants (along with their wild relatives) for salinity tolerance has two major advantages, first the tolerant genotype thus made available can be used in breeding programs and second, a comparative analysis at physiological/ biochemical and/or molecular level of these con- trasting cultivars can pave the way in understand- ing and unraveling novel survival mechanisms (Amtmann et al., 2005; Bohnert et al., 2006). It has been hypothesized that the mechanism of salt tolerance in halophytes are primarily the same as those known in glyco- phyte, with subtle differences in 'regulation' resulting in different responses towards salinity. Recent studies related to gene expression data in contrasting rice cultivars have further indicated that salinity tolerance of Pokkali may be due to constitutive overexpression of many genes that function in salinity tolerance and are stress inducible in IR64 (Kumari et al., 2008). Na? or Cl- may inhibit the activity of several enzymes and About four-fifths of the world's land area is in arid and semi-arid areas, in these areas, soil and water salinity limit crop productions and this limitation has led to reduced plants net production (Epstein and Rains, 1987). Excessive irrigation with saline water and poor drainage cause for increasing soil salinity, because after evapotranspiration of pure water from soil and plant surfaces, soil solute concentration is increased and water potential is decreased (Francois et al., 1994). For this reason one of the negative effects of salinity would know reducing water potential. One of the most effective methods for optimal use of water

resources and soil salinity is cultivating of moderately salt tolerant plants. Due to rapid increases of the world population and the corresponding increase in water requirements such as drinking, industry, agriculture and urban development, is importance planning to optimal use from it (Gareia *et al.*, 1998). Iran, on the one hand, due to the low rainfalls and inappropriate temporal and spatial distribution among the countries of the world is arid and semi-arid and on the other hand, due to population increase, urbanization and economic development, is faced with increasing demand for water. Salinity compared to other limiting materials that exist in the natural environment, is limit plant growth in broader range (Ghoulam *et al.*, 2002). Agricultural soils salinity and irrigation water can be a basic factor limiting plant growth in most parts of the world including Iran's. Plants growth decreases under salt stress due to lower water potential in the root, and special impact of the ions in metabolic processes. Reduction in plant growth in saline soils vary depending on the degree of resistance to salinity. Effective factors in plant growth in saline conditions includes: The potential reduction of water due to the presence of salts in root environment, cytotoxic effect of ions especially the sodium and chloride and ion imbalance between the ions of sodium, chloride, potassium nitrate and phosphate (Francisco *et al.*, 2002). In salinity stress, physiological drought as a major factor limits uptake of water from the soil. On the other hand, the increase in salt absorption by plants is impaired cellular processes and is damaged to physiological processes. Salt through increasing the osmotic pressure of soil solution, ions toxicity and disturb the balance of ions or nutritional deficiency cause damage to the plant.

Material and methods

To evaluate the effect of irrigation with different salinity on yield and quality of mustard, desired experiments was conducted in the farm of the Islamic Azad University of Mashhad Branch. Area of the farm is 1 hectares.The regional climate is arid and semi-arid, and average annual rainfall is 180 mm. This experiment was conducted in a completely randomized block design with three replications. Irrigation with saline water treatments began from stem elongation (leaf 8 onwards). In this experiment was used number of 12 cylindrical lysimeters made of plastic polyethylene with diameter of 60 cm and height of 100 cm. After installation of the lysimeter within the soil of farm (soil taken from a depth of 30 cm of agricultural land) was filled to a height of 85 cm. After filling the soil of farm was irrigated to soil moisture reach to Field Capacity (FC) and have been initial soil moisture for seeds planting. It should be noted that after the water is poured into the lysimeters remained for 10 days to leak into the soil does not fail experimenting process. We used sand on the lysimeters, evenly to a thickness of 1 cm, to prevent crust close of the soil surface of lysimeters. During the growing season up to the 8 leaf mustard with well water (control) was irrigated and then in the middle stages of growth was irrigated with saline water. In other words, the initial stage was irrigated with well water and in the intermediate stages of growth was applied salinity treatments with salinities of 2, 4 and 6 ds/m.

Mustard parameters measuring:

The measurement of Magnesium:

In this measurement method from Diethylene Triamine Pentaacetic Acid (DTPA) be used as a soil extractor that elements to be complexity extracted from the soil. A concentration that is used, it is very low (like water) for this reason that the concentration of micronutrients in soil is very low. Amount 5 g of soil pour into the flask and 10 cc of solution of DTPA extractor with a concentration of 0.005 Mol added to it and is shaking the resulting suspension for half an hour and obtained the purity extracts from it by the filter paper. After device setting and standards calibration, the elements concentration were determined by absorbance reading.

The measurement of Calcium:

For measurement of plant Calcium was used from metric complex method with EDTA. Procedures this is that initially 5 ml of plant extract, which prepared by dry method, mixture with normal concentration of 4 to pH of the extract is reach more than 12. Then pure a few milligrams of Moroxide powder to the color of soluble convert to pink and then with EDTA, was done titration to the soluble color convert to purple, and finally obtained the following formula amount of calcium:

$$\text{Calcium (\%)} = \frac{\text{Volume of consumed EDTA} \times \text{normalized EDTA} \times 20 \times 100 \times \text{total volume}}{\text{Weight of plants} \times \text{harvested extract volume} \times 1000}$$

To measure the plant Potassium was used the Flame Photometer. So as water and soil Potassium

measurements, the device is first calibrated by standards and then from plant extract and by Flame Photometer readings a numeric, which using the curve obtained in calibration step, the dissolved Potassium obtained. Way extract (dry method) of plant samples is in this case that the first be taken the one grams of powdered plant and at 500 ° C for 5 hour burned in a furnace and then added 100 ml of 2N hydrochloric acid to obtained ash and then add a little sterile water to it. The resulting soluble was heated on the stove sandy and eventually contents of the container is poured to the volumetric flask 100 ml and then volume is completed.

The measurement of Phosphorus:

For measuring of plant phosphorus was used from molybdenum yellow method. The way it works is that the first provide necessary standards and then 20 ml of plant soluble is poured to the volumetric flask 100 ml and by adding sterile water be conveyed to 50 ml. Then 20 ml of molybdenum reagent is added and is reached to volume of 100 ml by the sterile water and then be read by a device after uniform of the yellow color. Read numbers take on a chart, a graph was plotted from the calibration and standardization step that this graph shows different intensities for every various concentrations of phosphorus, and its concentration can be obtained by using a colorimeter.

Results and Discussion

After measuring salinity, potassium, magnesium, calcium and phosphorus in the mustard was conducted and these results were obtained: one of the effects of salinity on plant, is impact of adverse it, so that increasing the concentration of an ion than other ions through ion competition prevents the absorption of other ions by plants, thus, plant growth is reduced (table

various aspects occur in the plants under salinity stress. Salinity may affect nutrient availability, uptake, transport or distribution of nutrients within the plant or leads to increasing intrinsic in nutritional requirements of plants with inactivate the physiologic of consumed nutrients. Of course salinity simultaneously may effect on the one or several of these steps. There is no ability to absorb potassium, calcium, magnesium in higher salinities greater by plant, and the plant is able to absorb these ions to a certain level of salinity (Table 1). In the salt environment, mustard absorbed large amounts of ions such as chloride and sodium ions instead of calcium and potassium that this caused a shortage of these elements and finally will be followed reduces of growth (Francois, 1994). Antagonistic effect of absorbed sodium by plants and magnesium, potassium and calcium can be considered why in reduce of magnesium, potassium and calcium in mustard tissue and it can be said due to the high concentration of sodium ions in the external nutrient solution, absorption and internal concentrations of magnesium, potassium and calcium decreases. Because the concentrations of these ions by the sodium ion interfered and also reduced ionic activity in the solution external.

Potassium:

Statistical analysis showed a significant decrease in potassium levels after the treatments. Amount of it reduced from 810.79 to 646.57 (Table 2) showed effect different stress of salinity on potassium in aerial parts of mustard. Salinity treatments caused a significant reduction in the amount potassium in shoots compared to control treatment. It can be said that mustard after uptake of sodium ions from the soil and stored in plant tissues due to the antagonistic effect not be able to absorb of K from the soil. Accumulation of sodium and chloride in the plant results in increased osmotic pressure and the plant through this can cope with loss the osmotic potential of the roots (Francois, 1994). Since potassium is an essential element for plant growth, with increasing salinity and sodium ions in the environment prevented from potassium absorption. In a saline environment that sodium concentration is high, plants is adsorbed large amounts of sodium ions instead of potassium and calcium ions and eventually in plant growth is reduced. Due to the similar structure of sodium and potassium and sodium compete for the potassium connection positions, is inhibited metabolic processes relate to potassium in the cytoplasm and this subject indicated that amount of cellular sodium should be kept at a minimum level (Sairam and Srivastava, 2002).

Phosphorus:

Statistical analysis showed a significant decrease in phosphorus content after the treatments. The maximum amount of control is 73.65 and the minimum amount is 52.88 that was related to the highest rates of applied treatment (Table 2), phosphorus deficiency causes stunted growth of the plant and because the transfer of phosphorus from old leaves to young leaves cause the falling of old leaves. In saline environments is reduced activity of P in soil solution because of increasing ionic strength.

Magnesium:

Lack of Mg 2+ is prevented biosynthesis of proteins and been determined that this effect is due to the degradation of ribosomes into their subunits and transport of amino acids from Aminoacyl-tRNA into polypeptide chains is activated by magnesium (Francois, 1994). The role of magnesium in the carbohydrate loading and unloading in metabolism of the source, target been specified and with lack of Mg2+ loading in phloem decreases. In many plants, it has been shown that Na+ ions was caused reduce in uptake of the Mg2+ (Asraf *et al.*, 2004). Cultivation of Atriplex halimus L. in different concentrations of salt, with increasing salt led to decrease concentration of salt in leaves and roots and this decrease in other plants such as oranges (Gorham, 1993) and Lemon (Cramer *et al.* 1987) also observed that accompanied by a decrease in chlorophyll content.

Calcium:

Ca+ have important role in the metabolic processes. Calcium has important role in cell wall and stability of the plasma membrane and exclusivity of uptake ions, cell wall structural stability, regulation of ions transport, ion-exchange behavior control in Na+ / Ca+2 in plant growth.

Conclusion

Neutral and alkaline salts produced a similar level of growth inhibition on L. tenuis, whereas their combination mutually enhanced their effects. Such enhancement could be due in part to the detrimental effect on plant mineral nutrition derived from the 25% higher total Na? accumulation and the convergence of nutrient deficiencies produced by neutral and alkaline salts. The pattern of morphological changes in L. tenuis root architecture and carbon allocation upon the alkaline treatment (in the absence of NaCl) was similar to that from the mixed salt– alkaline treatment and different from that of the neutral one. Root morphological features here discussed are central factors in plant nutrient acquisition. Generally, the obtained results indicated that effect of salinity on plant processes is vary. The process of water absorption was favorable in control environments where the salinity concentration is zero but with increasing salinity levels decreased nutrient uptake by mustard. Sodium and chloride accumulation in leaves was caused plant toxicity and growth disorder and have along with nutrient absorption including Potassium. Also is reducing salts of sodium, magnesium, calcium and potassium in leaves. In this experiment a significant decrease in potassium, calcium, magnesium and phosphorus were observed (Table 1 and 2)

Table 1 Amounts of potassium, magnesium, calcium and phosphorus in mustard after applying salinity

Experiment type	P mg/100kg	Mg mg/100kg	Ca mg/100kg	K mg/100kg
Control Treatment	18.73	71.80	22.83	22.810
Treatment 1	12.68	35.76	44.77	53.790
Treatment 2	14.65	31.72	18.73	18.713
Treatment 3	27.53	17.64	77.67	66.640

Table 2 Comparing mean of potassium, calcium, phosphorus and magnesium-based treatments applied

Ec	P	Mg	Ca	K
0	a65 .73	a97 .80	a28 .83	a79.810
2	b03 .68	b0167 .76	b21 .77	b99.789
4	c9667 .64	c95 .71	c87 .72	c21.714
6	d88 .52	d27 .63	d3067 .67	d57.646

Note: Numbers with different letters are significantly different at the 1% level.

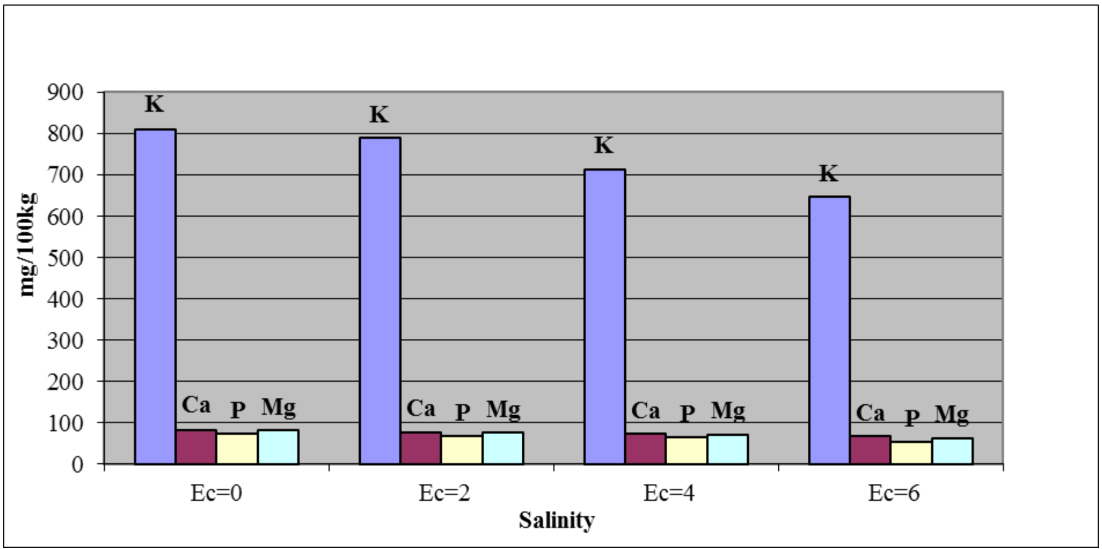

Figure 1: Effect of irrigation with different Ec on potassium, calcium, phosphorus and magnesium in mustard

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