*Mans. Sci. Bull. vol. 19(1):1-14*

# EFFECT OF ETHREL UNDER DIFFERENT LEVELS OF NaCl AND $MgCl_2$ ON GROWTH, YIELD AND SOME BIOCHEMICAL CONSTITUENTS OF WHEAT PLANTS

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*(Received: 21/8/1991)*

## ABSTRACT

*NaCl and $MgCl_2$ at 25 mM and their combinations with Ethrel increased number of tillers, stem and leaves dry weight, N% in stem and leaves as well as photosynthetic pigments in the leaves of wheat plants. Number of spikes and yield of grains per plant as well as carbohydrate content in the grains also increased. However, chloride salinity at 75 and 100 mM and their combinations with Ethrel decreased all these parameters. Moreover, low level of NaCl and $MgCl_2$ combined with Ethrel increased straw yield and protein content in the grains.*

*Ethrel enhanced the promotive effect of NaCl and $MgCl_2$ at 25 mM and partially overcame the depressing effect of higher salinity levels on growth, mineral uptake, yield and yield quality.*

*High salinity levels (50 and 75 mM) increased total amino acids content, whereas the higher level (100 mM) decreased this parameter.*

## INTRODUCTION

Salinity of either soil or water is considered the main problem that prevents improving or even maintaining crop production. The main effects of salinity are associated with ion accumulation in the plant rather than with reducion of water availability in the substrate (Zaher, 1989).

Salinity exerts different effects on plant growth and metabolism. Helal (1974) stated that NaCl depressed growth and protein synthesis as well as carbohydrate content of wheat. Helaly *et al.* (1985) showed that the low doses of Ethrel could partially overcome the depressing effect of salinity on P and K contents in camomile plants.

The present investigation aimed to study the effect of NaCl, $MgCl_2$ on growth, yield and chemical constituents of wheat. In addition the role of Ethrel on overcoming the depressing effect of salinity was investigated.

## MATERIALS AND METHODS

Pot experiments were carried out in the green house of the Fac. of Agric. Mansoura Univ. during the season of 1989.

Sand culture technique was used for this experiment. Wheat grains (Triticum aestivum L.) var. Sakha 69" were sown on Nov. 1st. Hoagland solution salinized with either NaCl or $MgCl_2$ (0.0, 25, 50 and 100 mM) was used. Each treatment was replicated 10 times and the pots were arranged in a complete randomized block design. Distilled water was used for irrigation till complete germination, thereafter the young plants were thinned to leave five plants per pot and watered with nutritive Hoagland solution prepared for each treatment whenever required. All the pots were flushed with distilled water once every two weeks to remove the accumulated salts. The plants were sprayed three times with either water or Ethrel (500 mg/l) after 21, 28, and 35 days from sowing. Two samples were taken at 50 and 80 days from sowing to record the following parameters: plant height, number of tillers, leaf area, stem and leaves dry weight. On the second sampling date (80 days from sowing) total nitrogen, phosphorus, potassium, sodium and magnesium were determined in the dry material of leaves and stems according to (A.O.A.C. (1970); Jackson (1967); Peterburgski (1968); Chapman & Paker (1961) respectively. Moreover, photosynthetic pigments were estimated in the 4th upper foliage leaf according to Wettestein (1957). At harvesting, the number of spikes and yield of both grains and straw per plant were recorded. Total carbohydate, protein and amino acids, were also determined in grains according to A.O.A.C (1970) and Block *et al.* (1958). The data were statistically analysed according to Steel and Torrie (1980).

## RESULTS AND DISCUSSION

Data in table (1) show that the low concentration of either NaCl or $MgCl_2$ (25 mM) increased plant height, number of tillers as well as the dry weight of both stems and leaves of wheat plants. Ethrel showed an additive effect to low salinity level on increasing tillering as well as dry weight of leaves and stems. In contrast it reduced plant height.

It is also clear that the high concentrations of NaCl or $MgCl_2$ (50, 75 and 100 mM) separated or combined with Ethrel decreased plant height, tillers number as well as leaves and stems dry weight. The experiments show also that leaf area was decreased by 100 mM salinity . Present data were more pronounced at $MgCl_2$ treatments. Ethrel could partially enhance growth under salinity to bring results nearly to control especially under 50 mM salinity.

The increase in growth and dry weight due to either NaCl or $MgCl_2$ at25 mM may be attributed to an increase in the contents of photosynthetic pigments and minerals (Table 2) as well as cytokinin (Sakr *et al.*, 1988).

The retarding effect of higher salinity levels (50, 75 and 100 mM) on growth and dry weight may be attributed to decreases in both meristimatic activity and cell elongation, in addition to the reduction in net photosynthesis and water absorption (Shwarz & Gale, 1981) and mineral content as shown in (Table 2). Moreover, there is evidence from the work of Sharz & Gale (1981) that salinity increased respiration rates indicating higher requirements. Strognov *et al.* (1970) have shown that the absorption of chloride salts from saline media and their accumulation up to toxic level may effect the metabolic activity of plat tissues and cuases the appearance of intermediate toxic compounds. Furthermore, Mass & Nieman (1978) suggested that there are two ways that salinity could retard growth by damaging growing cells so that they can not perform their functions or by limiting their supply of essential metabolites.

Ethrel was considered as an effective compound restoring plant growth capacity under salinization (Table 1). El-Hadidi *et al.* (1985) attributed this effect to the important role of Ethrel phosphorus on growth, decrease in chloride ion uptake and this in turn may increase salt tolerance of wheat plants.

Data in the present investigation postulate that Ethrel stimulates growth due to observed increase in photosynthetic pigments and mineral contents (Table 2).

Photosynthetic pigments:

Data in Table (2) show that the low level of either NaCl or $MgCl_2$ (25 mM) singly or after treatment with Ethrel increased photosynthetic pigments content in wheat leaves. The combined treatments with Ethrel were more effective in this respect. However, the high concentrations (50, 75 and 100 mM) of NaCl and $MgCl_2$ decreased this parameter, and the highest one (100 mM) was more effective in this respect. The data also show that Ethrel could partially overcome the depressing effect of salinity on photosynthetic pigments content.

The stimulating effect of low salinity level (25 mM) on photosynthetic pigments may be attributed to the enhancing effect of low salinity level on cytokinin content (Sakr *et al.*, 1988) and stimulating nitrogen uptake (Table 2) which may enhance chlorophyll biosynthesis.

The decrease in chlorophyll under high salinity levels (50, 75 and 100 mM) may be due to one or more of the following processes: the inhibitory effect of chloride on the activity of Fe-containing enzymes, cytochrome oxidase which in turn may decrease the rate of chlorophyll biosynthesis; the decrease in cytokinin biosynthesis in the roots which has as a consequence less hormone delivered to the shoots. Another possibility may be that abscisic acid activity may be increased in the stressed plants and this compound is known to accelerate leaf senescence (El-Hadidi *et al.*, 1985).

The role of Etrel on overcoming the depressing effect of salinity on photosynthetic pigments may be due to its enhacing effect on cytokinin content which promotes pigments biosynthesis (Sakr *et al.*, 1988).

Mineral constituents of stem and leaves

Data in Table (2) show that the low level of NaCl or $MgCl_2$ (25 mM) increased N and K percentage in both stem and leaves as well as P in the leaves. Ethrel showed an additive effect to salinity in this respect.

The high levels of both NaCl and $MgCl_2$ (50 & 75 and 100 mM) decreased N and P percentage in stem and leaves. The prementioned levels of NaCl separated or after treatment with Ethrel decreased K while those of $MgCl_2$ increased this parameter in both stem and leaves (Table 2). The high level (100 mM) was more effective in this respect. In addition, Ethrel could partially overcome the decreasing effect of salinity on the N constituent of wheat plants especially in the case of 50 mM which brings the results nearly to the control plants.

Data in Table (2) show also that all NaCl levels increased sodium and decreased magnesium percentage in both stems and leaves. On the other hand, $MgCl_2$ levels increased magnesium but decreased sodium percentage. Ethrel treatments of plants having salinity levels (50 & 75 and 100 mM) depressed partially sodium and magnesium percentages.

Data in Table (2) show further that NaCl and $MgCl_2$ at (25 mM) increased N percentage. This effect may be due to either a co-factor role of $Na^+$ and $Mg^{++}$ in enzymatic processes or to the increase in K uptake (Huber & Mereland, 1981). On the other hand, each of NaCl and $MgCl_2$ at 50, 75 and 100 mM decreased N percentage. This inhibiting effect may be attributed to the disturbance in cation balance, partially the abundance of sodium which, in turn, causes a disturbance in protein and nucleic acid metabolism (Helaly *et al.*, 1985).

The decline in potassium and phosphorus percentages under salinization was possibly due in part, to substitution mechanisms of sodium for one or more of these minerals and/or antagonistic state between sodium and one or more of tested elements present in the growth medium (Idris & Aslam, 1975). In addition, salinity depressed the availability of phosphorus and lowered the activity of phosphorus uptake. Moreover, there is a good evidence for hormonal regulation of ion uptake by plant cells under saline condition (Helaly *et al.*, 1985).

The decrease in phosphorus, potassium and magnesium percentages clarified the negative effect of NaCl on protein and carbohydrate contents in the shoots and grains of wheat since these elements are considered as co-factors for kinase, phosphorylase and transferase (Noggle & Fritz, 1976). In addition the progressive reduction in K percentage due to increasing salinity may be attributed to the antagonism between the exess of sodium and potassium (Shimose, 1972).

Regarding the effect of different levels of salinity (25, 50, 75 and 100 mM) on sodium and magnesium percentages, the present data confirm those obtained by Shimose (1972). Ethrel could partially overcome the toxic effect of high salinity levels due to its reduction role on sodium and magnesium accumulation (Table 2).

Yield and its components

Data presented in Table (3) show that the low level of either NaCl or $MgCl_2$ (25 mM) after treatment with Ethrel increased the number of spikes per plant. However, the higher levels (75 and 100 mM) alone or treated with ethrel decreased this parameter.

The low level of NaCl or $MgCl_2$ (25 mM) combined with Ethrel increased yield of grains and straw/plant. On the other hand, the higher salinity levels (50, 75 and 100 mM) decresed these parameters. The highest decrease was found by (100 mM). Again, Ethrel could partially overcome the depressing effect of salinity on yield and its components.

The increase in dry matter in wheat plants at 25 mM of either NaCl or $MgCl_2$ combined with Ethrel follows the same trend in photosynthetic pigments, N, P, K, and total carbohydrate contents. Such increase shows the relation of NaCl and $MgCl_2$ with the biosynthesis of carbohydrate and that brings higher yield (Tables 2 &3).

The reductioin in grains yield due to increase in salinity may be due to the decrease noticed in tillering (Table 1) and spikes number (table 3), and the reduction in straw yield is the result of the reduction in tillering and leaves area (Table 1).

Carbohydrate and protein percentage in the grains

Data in Table (3) show that (25 mM) of either NaCl or $MgCl_2$ combined with Ethrel increased carbohydrate and protein percentage in the grains, however NaCl treatment was more effective in this respect. Moreover, Ethrel increased the positive effect of both NaCl and $MgCl_2$ (25 mM) on increasing carbohydrate and protein percentage. Salinity at high levels (75 and 100 mM) decreased these parameters and $MgCl_2$ was more effective.

Ethrel could also partially overcome the depressing effect of salinity on carbohydrate and protein percentages in the grains of wheat plants treated with 50 mM NaCl and $MgCl_2$ which could bring results nearly similar to control plants.

NaCl or $MgCl_2$ (25 mM) combined with Ethrel promote the formation of carbohydrates may be possibly due to its enhancing effect on photosynthetic pigments biosynthesis and minerals uptake (Table 2). On the other hand the decrease in carbohydrate content under higher salinity levels (75 and 100 mM) may be due to their depressing effect on mineral uptake as well as diminishing of chlorophyll content (Table ).

Helaly *et al.* (1985) pointed out that the production of carbohydrates in plants grown under saline culture was limited in two ways: a) an adjustment in the internal osmotic pressure of the cell sap to go along with the external saline media by means of salt accumulation or increasing the intermediate substances or organic products; b) a production of higher energy by means of respiration in order to overcome the relatively low availability conditions of water and nutrition elements in saline media. Since carbohydrates are the principle substances used in respiration, a depression in the carbohydrate concentration of plant grown under saline condition could be expected.

Amino acids in the grains

Data presented in Table (4) show that the low level of NaCl or $MgCl_2$ (25 mM) brings amino acids content nearly to control plants. Whereas, the high levels (50 & 75 mM) increased this parameter in grains of wheat plants. In addition, NaCl (75 mM) was more effective in this respect. The increase in total amino acids may be attributed to partial increases in glutamic, glycine, alanine, phenylalanine and argenine. On the other hand 100 mM salinity slightly decreased this parameter.

The increase in free amino acids due to NaCl and $MgCl_2$ (50, 75 mM) may be attributed to their incomplete utilization in protein synthesis and/or to an increase in protein degradation (Ashoub *et al.*, 1984) or to the decrease in protein synthesis (Table 3).

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Table 1. Effect of NaCl, $MgCl_2$ and their combinations with Ethrel on morphological characters of wheat plants.

| Treatment | Plant height (cm) | | No. of tillers/ plant | | Leaf Area $(cm^2)$/ plant | | Stem D.wt. gm/plant | | Leaves D.wt. gm/plant | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sampling dates (Days from sowing) | | | | | | | | | |
| | 50 | 80 | 50 | 80 | 50 | 80 | 50 | 80 | 50 | 80 |
| Control | 43 | 102 | 3.6 | 4.5 | 115 | 191 | 1.6 | 3.8 | 1.6 | 4.0 |
| NaCl 25 mM | 46 | 107 | 3.8 | 4.7 | 117 | 194 | 1.8 | 4.1 | 1.9 | 4.3 |
| NaCl 25 mM + Ethrel | 44 | 101 | 4.2 | 5.3 | 124 | 195 | 1.9 | 4.2 | 2.0 | 4.5 |
| NaCl 50 mM | 41 | 100 | 3.3 | 4.3 | 104 | 185 | 1.3 | 3.6 | 1.4 | 3.7 |
| NaCl 50 mM + Ethrel | 33 | 95 | 3.7 | 4.6 | 111 | 187 | 1.5 | 3.7 | 1.7 | 3.8 |
| NaCl 75 mM | 38 | 97 | 3.2 | 4.1 | 106 | 181 | 1.3 | 3.4 | 1.2 | 3.4 |
| NaCl 75 mM + Ethrel | 32 | 91 | 3.3 | 4.3 | 109 | 167 | 1.5 | 3.5 | 1.4 | 3.5 |
| NaCl 100 mM | 31 | 92 | 3.8 | 3.6 | 97 | 168 | 1.0 | 3.0 | 0.9 | 2.9 |
| NaCl 100 mM + Ethrel | 28 | 85 | 3.0 | 3.7 | 103 | 171 | 1.2 | 3.1 | 1.0 | 3.1 |
| $MgCl_2$ 25 mM | 45 | 106 | 3.8 | 4.8 | 118 | 194 | 1.6 | 4.0 | 1.8 | 4.2 |
| $MgCl_2$ 25 mM + Ethrel | 43 | 97 | 3.8 | 5.1 | 123 | 185 | 1.8 | 4.1 | 1.9 | 4.2 |
| $MgCl_2$ 50 mM | 39 | 99 | 3.2 | 4.2 | 107 | 178 | 1.4 | 3.4 | 1.3 | 3.5 |
| $MgCl_2$ 50 mM + Ethrel | 33 | 86 | 3.5 | 4.3 | 109 | 181 | 1.7 | 3.6 | 1.4 | 3.7 |
| $MgCl_2$ 75 mM | 35 | 97 | 3.0 | 3.8 | 105 | 175 | 1.1 | 3.2 | 1.1 | 3.2 |
| $MgCl_2$ 75 mM + Ethrel | 30 | 87 | 3.1 | 4.2 | 105 | 171 | 1.3 | 3.6 | 1.2 | 3.4 |
| $MgCl_2$ 100 mM | 29 | 91 | 2.7 | 3.4 | 98 | 160 | 0.9 | 2.7 | 0.7 | 2.6 |
| $MgCl_2$ 100 mM + Ethrel | 24 | 77 | 2.5 | 3.4 | 98 | 160 | 1.1 | 2.9 | 0.8 | 2.9 |
| L.S.D. at 5% | 1.6 | 1.1 | 0.2 | 0.2 | 9 | 16 | 0.2 | 0.2 | 0.2 | 0.2 |

Table 2. Effect of NaCl, $MgCl_2$ and their combinations with Ethrel on photosynthetic pigments (mg/gm. f.wt) in leaves as well as nitrogen (N%), phosphorus (P%), potassium (K%), sodium (Na%) and magnesium (Mg%) in the leaves (L) and stems (S) of wheat plants.

| Treatments | Photo. Pig. | | N% | | P% | | K% | | Na% | | Mg% | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Chl. | Car. | S. | L. | S. | L. | S. | L. | S. | L. | S. | L. |
| Control | 3.3 | 1.2 | 0.57 | 1.05 | 0.55 | 0.65 | 1.9 | 2.6 | 1.2 | 1.0 | 0.9 | 0.6 |
| NaCl 25 mM | 3.6 | 1.3 | 0.60 | 1.11 | 0.57 | 0.66 | 2.1 | 2.9 | 1.7 | 1.3 | 0.9 | 0.5 |
| NaCl 25 mM + Ethrel | 3.9 | 1.5 | 0.65 | 1.14 | 0.58 | 0.67 | 2.4 | 3.0 | 1.4 | 1.1 | 0.8 | 0.4 |
| NaCl 50 mM | 3.1 | 1.1 | 0.51 | 0.96 | 0.52 | 0.60 | 1.6 | 1.5 | 2.2 | 2.0 | 0.8 | 0.4 |
| NaCl 50 mM + Ethrel | 3.2 | 1.2 | 0.57 | 0.99 | 0.51 | 0.62 | 1.8 | 1.8 | 2.0 | 1.6 | 0.7 | 0.3 |
| NaCl 75 mM | 1.8 | 1.0 | 0.50 | 0.88 | 0.48 | 0.56 | 1.4 | 1.4 | 2.6 | 2.4 | 0.7 | 0.4 |
| NaCl 75 mM + Ethrel | 1.9 | 0.9 | 0.51 | 0.94 | 0.51 | 0.57 | 1.7 | 1.7 | 2.2 | 2.0 | 0.6 | 0.2 |
| NaCl 100 mM | 1.5 | 0.9 | 0.41 | 0.80 | 0.41 | 0.46 | 1.1 | 1.1 | 2.8 | 2.5 | 0.7 | 0.3 |
| NaCl 100 mM + Ethrel | 1.8 | 1.0 | 0.45 | 0.82 | 0.42 | 0.50 | 1.2 | 1.3 | 2.3 | 2.1 | 0.6 | 0.2 |
| $MgCl_2$ 25 mM | 3.5 | 1.4 | 0.63 | 1.08 | 0.58 | 0.67 | 2.1 | 2.7 | 1.1 | 0.9 | 1.2 | 1.0 |
| $MgCl_2$ 25 mM + Ethrel | 3.8 | 1.5 | 0.65 | 1.11 | 0.52 | 0.68 | 2.4 | 2.9 | 1.0 | 0.9 | 1.3 | 0.9 |
| $MgCl_2$ 50 mM | 2.8 | 1.2 | 0.47 | 0.91 | 0.52 | 0.60 | 2.2 | 2.7 | 0.9 | 0.9 | 1.3 | 0.9 |
| $MgCl_2$ 50 mM + Ethrel | 3.1 | 1.2 | 0.56 | 0.98 | 0.53 | 0.60 | 2.5 | 2.8 | 0.9 | 0.7 | 1.2 | 0.9 |
| $MgCl_2$ 75 mM | 1.6 | 0.8 | 0.41 | 0.80 | 0.46 | 0.54 | 2.3 | 2.8 | 1.0 | 0.7 | 1.4 | 1.1 |
| $MgCl_2$ 75 mM + Ethrel | 1.8 | 0.9 | 0.48 | 0.82 | 0.48 | 0.56 | 2.5 | 2.8 | 0.9 | 0.6 | 1.3 | 0.9 |
| $MgCl_2$ 100 mM | 1.3 | 0.8 | 0.34 | 0.74 | 0.40 | 0.44 | 2.3 | 3.7 | 1.0 | 0.7 | 1.3 | 1.1 |
| $MgCl_2$ 100 mM + Ethrel | 1.6 | 0.8 | 0.41 | 0.80 | 0.42 | 0.46 | 2.4 | 2.8 | 0.9 | 0.6 | 1.3 | 0.9 |
| L.S.D. at 5% | 0.1 | 0.1 | 0.06 | 0.05 | 0.01 | 0.02 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |

Photo. Pig. : Photosynthetic pigments  Chl.: Chlorophylls
Car.: Carotenoids.

Table 3. Effect of NaCl, $MgCl_2$ and their combinations with Ethrel on yield and its components as well as yield quality (carbohydrates % and protein % in the grains).

| Treatments | No. of spikes /plant | Grains gm/plant | Straw gm/plant | Carbo-hydrates % | Protein% |
|---|---|---|---|---|---|
| Control | 5.4 | 4.1 | 17.6 | 66.8 | 14.2 |
| NaCl 25 mM | 6.1 | 4.5 | 18.7 | 73.0 | 14.9 |
| NaCl 25 mM + Ethrel | 6.6 | 5.6 | 21.5 | 83.5 | 17.4 |
| NaCl 50 mM | 5.0 | 3.3 | 13.4 | 63.2 | 13.0 |
| NaCl 50 mM + Ethrel | 5.1 | 3.8 | 15.6 | 65.3 | 13.6 |
| NaCl 75 mM | 3.2 | 2.0 | 12.4 | 60.0 | 11.1 |
| NaCl 75 mM + Ethrel | 3.7 | 2.8 | 13.3 | 62.9 | 12.4 |
| NaCl 100 mM | 2.8 | 1.9 | 11.6 | 54.0 | 8.6 |
| NaCl 100 mM + Ethrel | 3.1 | 2.5 | 12.5 | 61.0 | 10.5 |
| $MgCl_2$ 25 mM | 6.0 | 4.3 | 16.4 | 70.1 | 14.9 |
| $MgCl_2$ 25 mM + Ethrel | 6.9 | 5.1 | 20.4 | 81.1 | 16.7 |
| $MgCl_2$ 50 mM | 5.1 | 3.3 | 12.6 | 62.1 | 13.0 |
| $MgCl_2$ 50 mM + Ethrel | 5.0 | 3.8 | 14.7 | 64.8 | 13.6 |
| $MgCl_2$ 75 mM | 3.0 | 2.1 | 10.6 | 60.0 | 11.7 |
| $MgCl_2$ 75 mM + Ethrel | 3.3 | 2.8 | 13.5 | 61.0 | 12.4 |
| $MgCl_2$ 100 mM | 2.5 | 1.8 | 9.6 | 53.0 | 8.0 |
| $MgCl_2$ 100 mM + Ethrel | 2.8 | 2.2 | 10.8 | 56.1 | 8.8 |
| L.S.D. at 5% | 0.6 | 0.3 | 1.6 | 2.5 | 0.9 |

Table 4. Effect of NaCl, $MgCl_2$ and their combinations with Sthrel on amino acids concentration (mg/gm.D wt ) in grains of wheat plants

| Treatments | Glutamic | Aspartic | Phenylalanine | Alanine | Glycine | Lysine | Arginine | Methionine | Tyrosine | Total a.a | % control |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Control | 1.40 | 1.09 | 0.61 | 0.90 | 0.70 | 0.46 | 0.89 | 0.59 | 0.59 | 7.14 | 100 |
| NaCl 25 mM | 1.50 | 1.10 | 0.66 | 0.88 | 0.74 | 0.45 | 0.80 | 0.56 | 0.54 | 7.22 | 101 |
| NaCl 25 mM + Ethrel | 1.65 | 1.07 | 0.73 | 0.93 | 0.82 | 0.48 | 0.88 | 0.58 | 0.53 | 7.67 | 107 |
| NaCl 50 mM | 1.92 | 1.01 | 0.99 | 1.02 | 1.05 | 0.51 | 0.92 | 0.61 | 0.58 | 8.62 | 121 |
| NaCl 50 mM + Ethrel | 2.08 | 1.08 | 0.97 | 1.12 | 1.36 | 0.55 | 0.95 | 0.69 | 0.66 | 9.44 | 132 |
| NaCl 75 mM | 2.41 | 1.08 | 0.93 | 1.20 | 1.68 | 0.58 | 1.08 | 0.73 | 0.71 | 10.40 | 146 |
| NaCl 75 mM + Ethrel | 2.61 | 1.06 | 1.06 | 1.22 | 1.74 | 0.63 | 1.09 | 0.82 | 0.78 | 11.09 | 154 |
| NaCl 100 mM | 1.00 | 0.63 | 0.63 | 0.90 | 0.80 | 0.23 | 0.53 | 0.33 | 0.24 | 5.19 | 73 |
| NaCl 100 mM + Ethrel | 1.09 | 0.72 | 0.74 | 0.91 | 0.69 | 0.34 | 0.62 | 0.42 | 0.35 | 6.08 | 85 |
| $MgCl_2$ 25 mM | 1.40 | 0.96 | 0.66 | 0.83 | 0.73 | 0.49 | 0.86 | 0.58 | 0.63 | 7.14 | 100 |
| $MgCl_2$ 25 mM + Ethrel | 1.49 | 0.99 | 0.69 | 1.00 | 0.78 | 0.53 | 0.92 | 0.66 | 0.72 | 7.78 | 109 |
| $MgCl_2$ 50 mM | 2.03 | 0.96 | 0.92 | 1.02 | 0.96 | 0.53 | 1.03 | 0.63 | 0.77 | 8.85 | 124 |
| $MgCl_2$ 50 mM + Ethrel | 2.12 | 1.10 | 0.97 | 1.09 | 1.03 | 0.65 | 1.08 | 0.70 | 0.82 | 9.56 | 138 |
| $MgCl_2$ 75 mM | 2.33 | 1.06 | 0.86 | 1.06 | 1.58 | 0.53 | 1.08 | 0.76 | 0.77 | 10.03 | 140 |
| $MgCl_2$ 75 mM + Ethrel | 2.38 | 1.15 | 0.96 | 1.08 | 1.70 | 0.66 | 1.17 | 0.89 | 0.83 | 10.82 | 152 |
| $MgCl_2$ 100 mM | 0.86 | 0.51 | 0.56 | 0.72 | 0.69 | 0.26 | 0.46 | 0.26 | 0.26 | 4.54 | 64 |
| $MgCl_3$ 100 mM +Ethrel | 0.95 | 0.60 | 0.55 | 0.83 | 0.80 | 0.33 | 0.55 | 0.35 | 0.34 | 5.85 | 82 |

## تأثير الاتريل ومستويات مختلفة من كلوريد الصوديوم والمغنسيوم على النمو والمحصول وبعض المحتويات البيوكيماوية في نبات القمح

محب طه صقر
قسم النبات الزراعي – كلية الزراعة – جامعة المنصورة – مصر

أدى التركيز المنخفض (٢٥ ملليمول) لكل من كلوريد الصوديوم والمغنسيوم وكذلك تداخلاتهم مع الأتريل الى زيادة عدد الاشطاء – الوزن الجاف لكل من الساق والأوراق – المحتوى من النيتروجين في الساق والأوراق وكذلك صبغات البناء الضوئي في أوراق نبات القمح . اضافة الى ذلك فقد زاد محصول الحبوب ومحتواها من الكربوهيدرات ، بينما التركيزات المرتفعة لكلا الملحين (٧٥ ، ١٠٠ ملليمول) وكذلك تداخلاتهم مع الأتريل أدت الى نقص في هذه الصفات .

أدى التركيز المنخفض لكلا الملحين بالتداخل مع الأتريل الى زيادة محصول التبن ومحتوى الحبوب من البروتين .

أدى الأتريل الى زيادة التأثير المنشط للتركيزات المنخفضة لكلا الملحين (٢٥ ملليمول) كما عمل الأتريل على التغلب جزئيا على التأثير المثبط للملوحة العالية على النمو – امتصاص العناصر – المحصول ونوعيته .