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# SALINITY TOLERANCE OF WHEAT THROUGH SEED TREATMENT WITH DILUTED AND POTENTIZED SODIUM CHLORIDE

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Sodium chloride is known to inhibit the mitotic activity (Kuliava *et al.*, 1975), reduce the leaf area of plants due to the reduction in cell size (Meiri & Poljakoff-Mayber, 1967) and decrease the dry weight of whole plants by reducing its osmotic potential (Nukayz *et al.*, 1987). The main cause of NaCl-induced growth inhibition is the difficulty in uptake of mineral nutrients due to competition with $Na^+$ (Solovev, 1969). Bernstein (1964) classified salinity effects as toxic, osmoic and nutritional which in terms of stress terminology, the first one is a primary salt injury while the later two are secondary salt induced stresses. Primary injury due to NaCl salinity is increased by salt uptake. In raspberry, $Cl^-$ accumulated more in NaCl-treated plants than the $Na^+$ and therefore $Cl^-$ injury occured earlier and was more severe than Na+ injury (Ehlig, 1964). Tagawa & Ishizaka (1963) also concluded that the primary cause of salt injury to rice on transfer to 1% NaCl solution was due to $Cl^-$ accumulation in the shoots.

It is well known that a single salt solution of sodium salts is injurious to most plants at almost any concentration, but two salt solution consisting of NaCl and $CaCl_2$ in the ratio of 10: 1 is a balanced and nontoxic solution (Levitt, 1980). This phenomenon is known as ion antagonism. Keeping this in view the present study was undertaken to look into the effect of macrodiluted NaCl, instead of $CaCl_2$ on its antagonistic power to NaCl salinity.

Decimal potencies of NaCl or Natrium muriaticum (NM) were prepared in a small glass bottle by mixing 1 ml of 10% NaCl with 9 ml of distilled water to which 100 strokes was given using a mechanical shaker to get 1x (1%) potency of NM. Subsequent potencies (2x-8x) were prepared by mixing 1 ml of preceeding potency with 9 ml of water and shaken 100 times to get the next hihger potency. Effect of NM in a decimal scale (4x-NM, 6x-NM and 8x-NM) on the growth of wheat seedlings in the presenc of 0.6 and 0.8% NaCl salinity was investigated. Seeds of *Triticum aestivum* cv. TJ-83 were imbibed for 3h in 4x-NM (0.001% NaCl), 6X-NM (0.00001% NaCl) and 8x-NM (0.0000001% NaCl) and transferred to 9 cm Petri dishes containing two layers of filter papers soaked with 5 ml of 0.6 and 0.8% NaCl solutions. Three replicates with 10 seeds in each dish were used per treatment together with water as control. Petri dishes were incubated at $23 \pm 2°C$ with 12 h photoperiod under four 40 W flourescent tubes fixed at a distance of 0.5 m from the surface of the dishes. After 5 days, the length of coleoptile, shoot and root was measured. Coleoptile, shoot and root was significantly inhibited by both the salt treatments (Table 1). However, the growth inhibiting effects of 0.6 and 0.8% NaCl on coleoptile, shoot and root was significantly reversed by 4x and 8x potencies of NM treatments (Table 1). Salt-induced growth inhibition of wheat seedlings was not affected by 6x-NM treatment. Similarly, when the seeds were treated for 24 h with 4x, 6x and 8x-NM together with water as control in 9 cm Petri dishes and transferred to plastic pots containing sandy loam soil salinized with 0.6 and 0.8% NaCl solution, the NM treatment significantly reverted growth inhibition of shoot and root induced by 0.6 and 0.8% NaCl salinity (Table 2). Dry matter loss of

**Table 1. Effect of potentized Natrium Muriaticum (NM) in a decimal scale (4x-NM, 6x-NM, 8x-NM) on the growth of *Triticum aestivum* L. cv. TJ-83 seedlings in the presence of 0.6 and 0.8% NaCl salinity.**

| Treatment | Length after 5 days (cm) | | |
|---|---|---|---|
| | Coleoptile | Leaf | Root |
| Control | $3.49^{d}$ ±0.27 | $6.42^{c}$ ±0.57 | $25.46^{d}$ ±0.44 |
| 0.6% NaCl solution | $0.69^{ab}$ ±0.11 | $0.70^{a}$ ±0.10 | $6.06^{ab}$ ±0.34 |
| 4x-NM+0.6% NaCl solution | $2.26^{c}$ ±0.36 (56.1) | $2.14^{b}$ ±0.24 (25.1) | $12.99^{c}$ ±0.58 (35.7) |
| 6x-NM+0.6% NaCl solution | $0.71^{ab}$ ±0.15 (0.7) | $0.71^{a}$ ±0.15 (0.2) | $6.35^{ab}$ ±0.63 (1.5) |
| 8x-NM+ 0.6% NaCl solution | $2.02^{c}$ ±0.09 (53.9) | $2.56^{b}$ ±0.34 (32.5) | $12.73^{c}$ ±0.35 (34.4) |
| 0.8% NaCl solution | $0.46^{a}$ ±0.10 | $0.46^{a}$ ±0.10 | $5.39^{a}$ ±0.63 |
| 4x-NM+0.8% NaCl solution | $0.93^{ab}$ ±0.08 (15.5) | $0.95^{a}$ ±0.06 (8.2) | $7.39^{b}$ ±0.93 (10.5) |
| 6x-NM+0.8% NaCl solution | $0.90^{ab}$ ±0.33 (14.5) | $0.91^{a}$ ±0.34 (7.5) | $5.68^{ab}$ ±0.76 (1.4) |
| 8x-NM+ 0.8% NaCl solution | $1.24^{b}$ ±0.14 (25.7) | $1.80^{b}$ ±0.10 (22.5) | $7.33^{ab}$ ±0.57 (10.2) |

NM = Natrium Muriaticum

Mean within a column followed by different letters are significantly different at 0.05 probability level. Per cent reversion is given in parenthesis.

$$\% \text{ Reversion} = \frac{(\text{NaCl} + \text{Reverting agent}) - \text{NaCl}}{\text{Control} - \text{NaCl}} \times 100$$

**Table 2. Effect of potentized Natrium Muriaticum (NM) in a decimal scale (4x-NM, 6x-NM, 8x-NM) on the growth of *Triticum aestivum* L. cv. TJ-83 after 7 days of growth in sandy soil under NaCl salinity.**

| Treatment | Shoot length (Cm) | % of Control | Root length (Cm) | % of Control |
|---|---|---|---|---|
| Control | $8.52^{e}$ ±0.40 | 100 | $7.95^{e}$ ±0.20 | 100 |
| 0.6% NaCl solution | $3.10^{ab}$ ±0.16 | 36.4 | $4.69^{b}$ ±0.41 | 59 |
| 4x-NM + 0.6% NaCl solution | $5.51^{cd}$ ±0.08 (44.6) | 64.7 | $5.60^{bc}$ ±0.42 (27.9) | 70.4 |
| 6x-NM+0.6% NaCl solution | $6.31^{d}$ ±0.23 (59.2) | 74.1 | $7.15^{de}$ ±0.07 (75.5) | 89.9 |
| 8x-NM+0.6% NaCl solution | $6.04^{d}$ ±0.05 (54.2) | 70.9 | $6.01^{cd}$ ±0.58 (40.5) | 75.6 |
| 0.8% NaCl solution | $3.00^{ab}$ ±0.34 | 35.2 | $3.57^{a}$ ±0.25 | 44.9 |
| 4x-NM+0.8% NaCl solution | $5.58^{cd}$ ±0.64 (46.7) | 65.5 | $6.15^{cd}$ ±0.45 (58.9) | 77.4 |
| 6x-NM+0.8% NaCl solution | $4.37^{bc}$ ±0.54 (26.3) | 51.3 | $5.09^{bc}$ ±0.38 (34.7) | 64 |
| 8x-NM+0.8% NaCl solution | $3.93^{ab}$ ±0.30 (16.8) | 46.1 | $5.76^{bc}$ ±0.20 (50.0) | 72.5 |

NM = Natrium Muriaticum

Mean within a column followed by different letters are significantly different at 0.05 probability level. % Reversion in parenthesis.

shoot due to 0.6% NaCl salinity was also overcome partly by 4x 6x and 8x potencies of the same salt (Table 3). The decrease in dry matter of shoot due to 0.6% NaCl treatment was 41% reverted by 4x-NM, 60% by 6x-NM and 46% by 8x-NM treatments (Table 3). Thus growth reduction due to NaCl salinity could partly be neutralized by employing diluted and potentized NaCl. Similarly, ABA treatment to NaCl-salinized plants was also found to reverse the inhibitory effects of 15 mM NaCl on fresh and dry weights of *Lens culinaris* L., shoots and roots (Bano & Hayat, 1995).

**Table 3. Effect of potentized Natrium Muriaticum (NM) in a decimal scale (4x-NM, 6x-NM, 8x-NM) on the dry weight changes of shoot and root of *Triticum aestivum* L. cv. TJ-83, after 7 days of growth in sandy soil under NaCl salinity.**

| Treatment | Dry weight of shoot per plant (mg) | Dry weight of root per plant (mg) |
|---|---|---|
| Control | 6.7[c] ±1.13 | 33.3[ab] ±3.33 |
| 0.6% NaCl solution | 1.7[a] ±0.33 | 30.3[ab] ±3.23 |
| 4x-NM+0.6% NaCl solution | 3.7[ab] ±0.88 (41.2) | 19.3[a] ±6.36 |
| 6x-NM+0.6% NaCl solution | 4.7[bc] ±0.33 (60.0) | 53.3[cd] ±6.67 |
| 8x-NM+ 0.6% NaCl solution | 4.0[ab] ±1.50 (46.0) | 61.9[d] ±6.10 |

NM = Natrium Muriaticum.

Mean within a column followed by different letters are significantly different at 0.05 probability level % Reversion in parenthesis.

## References

Bano, A. and S. Hayat. 1995. Effect of abscisic acid on the physiological and biochemical contents of *Lens culinaris* L., under saline conditions. pp. 94-98. In: Biology of salt tolerance. (Eds.) M.A. Khan and I.A. Ungar Department of Botany, University of Karachi.

Berstein, L. 1964. Effect of salinity on mineral composition and growth of plants. *Plant Anal. Fert. Probl. Colloq.*, 4: 25-45.

Ehlig, C.F. 1964. Salt tolerance of raspberry, boysenberry and blackberry *Proc. Amer. Soc: Hort. Sci.*, 85: 318-324.

Kulieva, F.B., Z.B. Shamina and B.P. Strogonov. 1975. Effect of high sodium chloride concentrations on the *in vitro* cell division of *Cepris capillaris*. *Fiziol. Rast.*, 22: 131-135.

Levitt, J. 1980. *Responses of plants to environmental stresses*. Volume II. Water, Radiation, Salt and other stresses. pp: 365-488. Academic Press, New York.

Meiri, A. and A. Poljakoff-Mayber. 1969. Effect of variations in substrate salinity on growth of bean leaves in thickness and in area. *Isr. J. Bot.*, 16: 115-123.

Nukaya, A.M. Masui and A. Ishida. 1982. Salt tolerance of green soybean (*Glycine max* cultivar Hakucho) as affected by various salinities in sand culture. *J. Jour. Soc. Hort. Sci.*, 60: 487-496.

Solov'ev, V.A. 1969. Plant growth and water and mineral nutrient supply under NaCl salinization conditons. *Fiziol. Rast.*, 16: 870-876.

Tagawa, T. and N. Ishizaka. 1963. Physiological studies on the tolerance of rice plants to salinity. II. Effects of salinity on the absorption of water and chloride ion. *Proc. Crop. Sci. Soc. Jap.*, 31: 337-341.

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