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K:Na

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H⁺-ATPase

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(*Triticum*

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(*Prosopis juliflora* L.)

aestivum L.)

NFT

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'White Boston' (Butterhead)

(Na₂SiO₃, 5H₂O)

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2. Kjeltec

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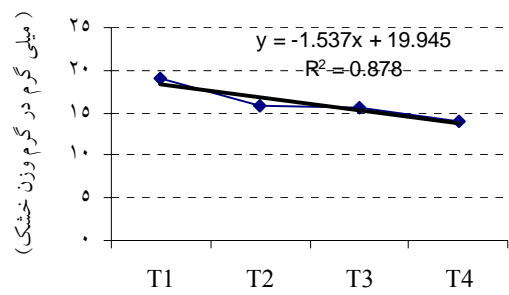
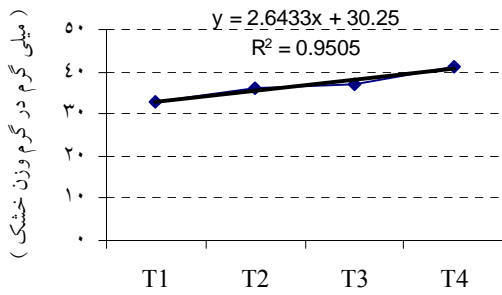
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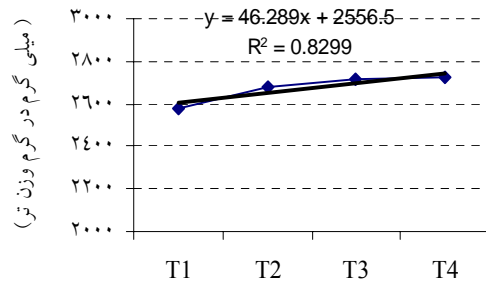
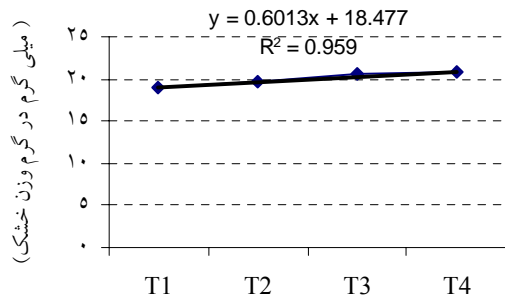
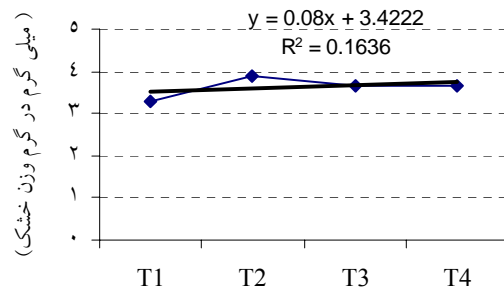
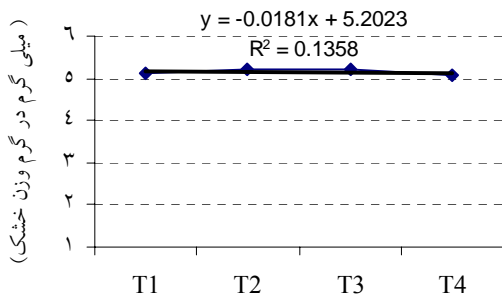
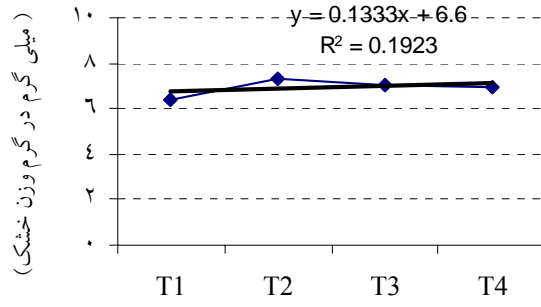
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H⁺-ATPase

H⁺-ATPase
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ATP-driven H⁺

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H⁺-ATPase

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Na⁺/H⁺

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Na⁺/H⁺

H⁺-

H⁺-PPase

H⁺-

ATPase

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ATPase

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Na⁺/H⁺

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H⁺-

H⁺-ATPase

H⁺-ATPase

PPase

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Na⁺/H⁺

H⁺-PPase

H⁺-ATPase

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Na⁺

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Na⁺

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1. Na⁺/H⁺ antiporter

5. Dehghanipoor, M. 2003. Effect of nutrient solutions on the yield and quality of lettuce (*Lactuca sativa* L.) using NFT-System. MSc. Thesis submitted to Guilan University, Rasht, Iran.
6. Ehyae, A. & M.A. Behbahanizadeh. 1993. A description of soil chemistry analysis method. Soil and Water Institution, No. 893.
7. Epstein, E. 1994. The anomaly of silicon in plant biology, Proc. Natl. Acad. Sci. U.S.A. 91: 11– 17.
8. Epstein, E. 1999. Silicon. Annu. Rev. Plant Physiol. Plant Mol. Biol. 50: 641– 664.
9. Epstein, E. & A. Bloom. 2004. Mineral nutrition of plants: principle and perspectives. Second Edition.
10. Flower, T.J., S.A. Flower, & H. Greenway. 1986. Effects of sodium chloride on tobacco plants. Plant Cell and Environment 9: 645– 651.
11. Flowers, T.J. & D. Dalmond. 1992. Protein synthesis in halophytes: the influence
12. of potassium, sodium and magnesium in vitro. Plant and Soil. 146: 153– 161.
13. Ghoulam, C., A. Foursy, & K. Fares. 2002. Effects of salt stress on growth, inorganic ions and praline accumulation in relation to osmotic adjustment in five sugar beet cultivars. Environmental and Experimental Botany. 47: 39– 50
14. Grattan, S.R. & C.M. Grieve. 1994. Mineral nutrient acquisition and response by plants grown in saline environments. In: Pessaraki, M. (Ed.), Handbook of Plant and Crop Stress. Marcel Dekker, New York, pp. 203– 226.
15. Grattan, S.R. & C.M. Grieve. 1999. Salinity–mineral nutrient relations in horticultural crops. Scientia Horticulturae. 78: 127– 157.
16. Hill, J.H., D.G. Mortley, D.R. Hileman, C.K. Bonsi, & W.A. Hill. 2001. Light and CO₂ interaction on peanut grown in Nutrient Film Technique. Acta Horticulture. 548: 327–330.
17. Husain, S., S.V. Caemmerer, & R. Munns. 2004. Control of salt transport from roots to shoots of wheat in saline soil. Functional Plant Biology. 31(11): 1115–1126.
18. Inanaga, S. & A. Okasaka. 1995. Calcium and silicon binding compounds in cell walls of rice shoot. Soil Sci. Plant Nutr. 41: 103–110.
19. Karimaie, M.S. 1994. Effect of three nutrient solutions on vegetative characteristics and mineral uptake by four lettuce cultivars in soilless culture. MSc. Thesis submitted to Tabriz University, Tabriz, Iran.
20. Khan, M.G., M. Silvesbusch, & S.H. Lips. 1994. Physiological studies on salinity and nitrogen interaction in alfalfa. I. Biomass production and root development. J. Plant Nutr. 17: 657–668.
21. Lazof, D.B. & A. Luchli. 1991. The nutritional status of the apical meristem of lactuca sativa as affected by NaCl salinization: an electron-probe microanalytic study. Planta. 184: 334– 342.
22. Lazof, D.B. & N. Bernstein. 1999. The NaCl induced inhibition of shoot growth: the case for disturbed nutrition with special consideration of calcium, Adv. Bot. Res. 29: 113– 189.
23. Leidi, E.O., M. Silberbush, & S.H. Lips. 1991. Wheat growth as affected by nitrogen type, pH and salinity. II. Photosynthesis and transpiration. Journal of Plant Nutrition. 14: 247– 256.
24. Liang, Y.C. 1998. Effects of silicon on leaf ultrastructure, chlorophyll content and photosynthetic activity in barley under salt stress. Pedosphere. 8: 289–296.
25. Liang, Y.C. 1999. Effects of silicon on enzyme activity and sodium, potassium and calcium concentration in barley under salt stress. Plant and Soil. 29: 217– 224.
26. Liang, Y.C., Q.R. Shen, Z.G. Shen, & T.S. Ma. 1996. Effects of silicon on salinity tolerance of two barely cultivars, J. Plant Nutr. 19: 173–183.
27. Liang, Y.C., W.H. Zhang, Q. Chen, & R.X. Ding. 2005. Effects of silicon on tonoplast H⁺-ATPase and H⁺-PPase activity, fatty acid composition and fluidity in roots of salt-stressed barley (*Hordeum vulgare* L.). Environ. Exp. Bot. 53: 29–37.
28. Liang, Y.C., W.H. Zhang, Q. Chen, Y. Liu, & R.X. Ding. 2006. Effect of exogenous silicon (Si) on H⁺-ATPase activity, phospholipids and fluidity of plasma membrane in leaves of salt-stressed barley (*Hordeum vulgare* L.). Environmental and Experimental Botany 57: 212– 219.

29. Lutts, S., J. Bouharmont, J.M. Kinet. 1999. Physiological characterization of salt-resistant rice (*Oryza sativa* L.) somaclones. *Aust. J. Bot.* 47: 835–849.
30. Lutts, S., J.M. Kinet, J. Bouharmont. 1996. NaCl-induced senescence in leaves of rice (*Oryza sativa* L.) cultivar differing in salinity resistance. *Ann. Bot.* 78: 389–398.
31. Ma, J.F. & E. Takahashi. 1993. Interaction between calcium and silicon in water-cultured rice plants. *Plant Soil.* 148: 107–113.
32. Marschner, H. 1995. *Mineral Nutrition of Higher Plants*. Academic Press Limited: London. P: 889.
33. Matoh, T., P. Kairusmee, & E. Takahashi. 1986. Salt-induced damage to rice plants and alleviation effect of silicate. *Soil Sci. Plant Nutr.* 32 295–304.
34. Munns, R. & A. Termaat. 1986. Whole-plant responses to salinity. *Aust. J. Plant Physiol.* 13: 143–160.
35. Murillo-Amador, B., H.G. Jones, C. Kayac, & R. L. Aguilar. 2006. Effects of foliar application of calcium nitrate on growth and physiological attributes of cowpea (*Vigna unguiculata* L. Walp.) grown under salt stress. *Environmental and Experimental Botany.* 58: 188–196.
36. Neel, J.P.S., G. Alloush, A.D.P. Belesky, & W.M. Clapham. 2002. Influence of rhizosphere ionic strength on mineral composition, dry matter yield and nutritive value of forage chicory. *J. Agron. Crop Sci.* 188: 398–407.
37. Niu, X., R.A. Bressan, & P. M. Hasegawa. 1995. Ion homeostasis in NaCl stress environments. *Plant Physiol.* 109: 715–742.
38. Okuda, A., & E. Takahashi. 1965. The role of silicon. In *The Mineral Nutrition of the Rice Plant*. pp 123–146. Proc. Symposium of the International Rice Research Institute. Johns Hopkins Press. Baltimore, MD.
39. Parida, A.K., A.B. Das, Y.Sanadac, & P. Mohanty. 2004. Effects of salinity on biochemical components of the mangrove, *Aegiceras corniculatum*. *Aquatic Botany* 80: 77–87.
40. Rengel, Z., 1992. The role of calcium in salt toxicity. *Plant Cell Environ.* 15, 625–632.
41. Ruiz, D., V. Martinez, & A. Cerda. 1997. Citrus response to salinity: growth and nutrient uptake. *Tree Physiol.* 17: 141–150.
42. Sady, W., S. Myczkowski. 1995. Effect of different form of nitrogen on the quality of lettuce yield. *Acta Horticulture.* 401: 115-121.
43. Stamatakis, A., Papadantonakis, N., Savvas, D., Lydakis-Simantiris, N. & Kefalas, P. 2003. Effects of silicon and salinity on fruit yield and quality of tomato grown hydroponically. *Acta Horticulture.* 609:141-147.
44. Tarakcioglu, C., & A. Inal. 2002. Changes induced by salinity, demarcating specific ion ratio (Na/Cl) osmolality in ion and proline accumulation, nitrate reductase activity and growth performance of lettuce. *Journal of Plant Nutrition.* 25: 27–41.
45. Tolaie, M. 2001. *Guidness of producted cultivation in soilles culture*. Agricultural Education Press. Tehran, Iran.
46. Yeo, A.R., Flowers, S.A., Rao, G., Welfare, K., Senanayake, N., & Flowers, T.J.1999. Silicon reduces sodium uptake in rice (*Oryza satival* L.) in saline conditions and this is accounted for by a reduction in the transpirational bypass flow. *Plant Cell Environ.* 22: 559–565.
47. Young, R. H., Eunjoo., L. Youngbeom., Y. Cho., E. Hahn., Y. B. Lee., J. M. Lee., K. C. Gross., A. E. Watada., & S. K. Lee. 1997. Effect of nutrient control on the growth of lettuce in Nutrient Film Technique. *Acta Horticulture.* 483: 161–165.