Effect of Salinity on Growth and Development of Date Palm

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Abstract

Although date palm is classified as a salt resistant tree, however high level of salt in the soil or irrigation water has a considerable negative impact on its growth and productivity besides the reduction of survival rate of offshoots cultured in salty soil. This presentation will focus on the current aspects of our research work at the University of Basra to improve salt tolerance of date palm by exogenous application of some chemicals that have a positive effect on growth and fruiting of date palm under saline condition. Also we have done a series of research work to produce salt resistant date palm plantlets through callus culture and somatic embryogenesis under high concentration of NaCl salt. Sulfur is an essential nutrient that play role in plant development in reversing the adverse effects of abiotic stress because of its ability to scavenge free radicals that produced under salt stress and stimulate the anti-oxidative defense system. Sulfur also plays role in activation of several enzymes and the acidity that produced during elemental sulfur oxidation increases the availability of nutrients which enhance plant growth. To study the effect of sulfur on growth of offshoots of two date palm cultivars ('Barhi' and 'Sayer') grown in Basra, sulfur was added at three rates (0, 100 gm and 200 gm per offshoots). The offshoots cultured in salty soil (EC 15.9 ds/m). Results were taken after 7 months of treatment which showed that sulfur at level of 200gm caused a significant increase of offshoot height, leaf area, number of leaves and girth compared with control treatment. Also, sulfur application influenced biochemical characteristics of offshoots such as total chlorophyll, dry weight, carbohydrates, proline, protein, peroxidase enzyme activity and endogenous indolacetic acid content compared with control treatment. Sulfur at 200gm rate decreased catalase enzyme activity and abscisic acid content. Level of Na and Cl ions were decreased in leaves by sulfur treatment and improved salinity tolerance of offshoots by maintaining high ratio of K /Na ions. Calcium also used as a foliar spray or soil application by Polixal (8% Ca) and Rexene (9.7% Ca) which are a liquid commercial product as a source of Ca. Polixal added to the soil around the offshoots by rate of 15 and 30 ml per offshoot while Rexene used as a foliar spray at concentrations of 1000 and 2000 ppm. Results showed that Polixal at 30 ml per offshoots increased all vegetative criteria and biochemical contents of offshoots by the improvement of antioxidant defense system under salt stress. Another experiment was conducted on adult trees of 'Sayer' date palm cultivar grown in salty soil (Ec 17.2 ds/m). Treatments included addition of sulfur (200 and 400 gm/tree), calcium as calcium nitrate (100 and 200gm/tree)

and citric acid (100 and 200gm/tree) to the soil. Those materials were added to the soil twice per year at mid-March and mid-October. The results indicated that addition of sulfur (400gm/tree) and citric acid (200gm/tree) increased fruit set, leaf area and improved fruit physical and chemical characteristics such as fruit weight, size, total sugar and total soluble solids. Calcium at 200gm/tree also increased leaf area. Addition of sulfur at 200 and 400 gm/tree, calcium at 100gm/tree and citric acid at 200gm/tree caused an increase in bunch and total yield compared with control treatment. K and Ca ions were significantly increased by sulfur treatment at 400 gm/tree and the ratio of K to Na ions were also increased by sulfur addition. To use tissue culture technique to produced salt resistant plantlets, calluses of 'Barhi' date palm cultivar were cultured on different concentrations of NaCl salt (0, 200, 300 and 400mM) alone or in combination with some chemical compounds such as, trehalose sugar, proline, PEG and salicylic acid at different concentrations. The effect of above treatments and their combination were studied in relation to their effects on fresh weight of embryogenic callus, soluble carbohydrates, proline, Na ion, K ion and activity of peroxidase and catalase enzymes. The effects of the above treatments were also studied on changes in protein pattern as well as the genetic variability of regenerated plantlets using RAPD technique. NaCl at 300 and 400 mM decreased calls fresh weight, whereas 200 mM of NaCl and trehalose at 10 gm/l significantly increased callus fresh weight. Proline concentration of embryogenic callus increased at 300 and 400 mM NaCl, 10gm/l trehalose and 50 mg/l salicylic acid. Pretreatment with PEG 1% decreased proline concentration of callus. NaCl at 300mM decreased peroxidase activity, whereas trehalose at 10 gm/l increased the activity of peroxidase. NaCl at 400 mM , trehalose at 10gm/l, proline at 50 mg/l and salicylic acid at 50 mg/l caused a significant increase in the activity of catalase. Treatment with NaCl had a significant effect on the process of gene expression that caused the disappearance of certain proteins and appearance of a single protein with molecular weight of 22.67 KD especially at the concentration of 400mM NaCl.Treatment with chemical compounds also caused appearance of low molecular weight proteins with the range of 20.89 to 27.02 KD. Plantlets were regenerated from embryogenic callus from the control treatment, as well as the interaction treatments among NaCl and trehalose, PEG and proline. Plantlets were acclimatized for 7 months with an average of survival rate of 85% that adapted to salty conditions. In conclusion, it is possible to improve date palm tolerance to salty condition by addition of different chemical materials to the soil growing offshoots and adult plants. Much research is needed to produce transgenic date palm that withstands high salt stress condition.