Effect of some agricultural treatments on tomato plants adaptation to tolerate salinity stress

Yasser Abd El-Hakim Mohamed Ahmed Salama

SummaryThis study was carried out in the research experimental farm in Ras Sider, South Sinai governorate, Egypt during the two successive seasons of 2005 and 2006. The study aimed to investigate different agricultural techniques to alleviate the negative effects of salinity on growth and production of tomato plants. The study used two tomato genotypes namely VT 737 hybrid and Super strain B cultivar.Nursery period:During nursery stage the seeds of both genotypes received the same fertilization doses and salinity hardening treatments were applied. Salinity hardening treatments were carried out using four levels ofirrigation water namely•Control (tap water — 250 ppm),•Low level (1500 ppm)•Medium level (3000 ppm)•High level (4500 ppm)Each week and for five weeks period, irrigation with the above mentioned salinity levels were applied as follow: First day: irrigation with proposed salinity levels, Second day: fasting no irrigation, Third day: leaching with tap water, Fourth day: irrigation with proposed salinity levels, Fifth day: fasting no irrigation, Sixth day: leaching with tap water and seventh day: irrigation with proposed salinity levels. No other treatments were applied at this stage.Samosa,Field period:Plants grown in the nursery and treated with the above mentioned hardening treatments were transplanted into the open field in Ras Sedr Research Station in South Sinai. The irrigation was carried out using water from underground well with about 5500 ppm salinity. Soil was prepared by adding proper doses of fertilizers and cattle manure as applied in the district. Fertilization treatments with specific compounds were applied with irrigation water every ten days. Fertilization treatments were as follow:1.Potassium humate (Humic acid 85% - 12 % K2O) in a rate of 4 gm/liter water,2.Mixture of amino acids in a rate of 2 gm/liter,3.Mono potassium phosphate in a rate of 3 gm/liter4.Control.The experiment was designed as a split-split plot with the genotypes in the main plot and fertilization in the sub-main and the salinity hardening in the sub-sub main plots with three replications.The results were as follow:7.1. General Effects of experimental factors: 7.1.1 Effect of tomato genotypes:The effect of genotype was very clear where the VT 737 hybrid showed higher significant performance in vegetative growth parameters i.e plant height, leaf area, fresh and dry weights of shoots.SaotmwrfPhysiological parameters such as TSS of the leaves, osmotic pressure, stomatal conductivity, transpiration rate and leaf temperature were all in favor of VT 737 hybrid compared to super strain B.Yield production in terms of fruits number, total yield per plant and total yield per feddan were also positively affected by the genotypes where VT 737 hybrid was significantly higher than super strain B.Fruit quality expressed as average fruit weight, and TSS recorded higher values in VT 737 compared to super strain B.Chemical contents recorded higher values for total N, P, K, Ca, and Mg and lower value for Na and proline in VT 737 hybrid compared to Super strain B. The same trends for this treatment were recorded in the fruits for total carbohydrate, ascorbic acid, Ca, total protein as well as forNa content. 7.1.2 Effect of fertilization:The fertilization treatments such as mono potassium phosphate, potassium humate and amino acids reduced the negative effects of salineconditions on tomato plant.The effect of fertilization was very clear where mono potassium phosphate showed higher significant effect on vegetative growth parameters i.e plant height, leaf area, fresh and dry weights of shoots.Physiological parameters such as TSS of the leaves, osmotic pressure, stomatal conductivity, transpiration rate and leaf temperature were all in favour of fertilization treatment of mono potassium phosphate comparedto all other fertilization treatments.Summet,Yield production in

terms of fruits number, total yield per plant and total yield per feddan were also positively affected by the fertilization treatments where mono potassium phosphate was significantly higher than all other fertilization treatment.Fruit quality expressed as average fruit weight, and TSS recorded higher values with mono potassium phosphate compared to all other fertilization treatments.Chemical contents recorded higher values for total N, P, K, Ca, and Mg and lower value for Na and proline in mono potassium phosphate compared to all other fertilization treatments. The same trends for this treatment were recorded in the fruits for total carbohydrate, ascorbic acid, Ca, total protein as well as for Na content. 7.1.3 Effect of salinity hardening:Salinity hardening treatments generally improved plant vegetative and physiological growth parameters, yield and its components and chemical contents in the leaves and fruits compared to control treatments.The effect of salinity hardening was very clear where 3000 ppm salinity showed higher significant effect on vegetative growth parameters i.e plant height, leaf area, fresh and dry weights of shoots.Physiological parameters such as TSS of the leaves, osmotic pressure, stomatal conductivity, transpiration rate and leaf temperature were all in favour of salinity hardening treatment of 3000 ppm compared to all other hardening treatments.ScattotavyYield production in terms of fruits number, total yield per plant and total yield per feddan were also positively affected by the salinity hardening treatments where the medium level of hardening (3000 ppm) was significantly higher than all other salinity hardening treatments.Fruit quality expressed as average fruit weight, and TSS recorded higher values with medium level of salinity hardening (3000 ppm)compared to all other hardening treatments.Chemical contents in the shoots recorded higher values for total N, P, K, Ca, and Mg and lower value for Na and proline in the medium level of salinity hardening (3000 ppm) compared to all other salinity hardening treatments. The same trends for this treatment were recorded in the fruits for total carbohydrate, ascorbic acid, Ca, total protein as well as for Nacontent.7.2. Effect of second order interaction between two factors:7.2.1 Effect of second order interaction between • eno es and fertilization:The interaction between genotype and fertilization treatments improved vegetative (plant height, leaf area, fresh and dry weights of shoots) physiological growth parameters (TSS of the leaves, osmotic pressure, stomatal conductivity, transpiration rate and leaf temperature) and yield components (fruits number, total yield per plant and total yield per feddan), fruit quality (average fruit weight, TSS) and chemical content (total carbohydrates, total protein, ascorbic acid, Ca and Na) as well as chemical contents in the shoots (total N, P, K, Ca, Mg) andlowering Na, proline. The best interaction effect was obtained with the VT 737 hybrid receiving the fertilization treatment of mono potassium phosphate followed by the same hybrid treated with potassium humate. 7.2.2 The second order interaction between the genotype and salinity hardening:The interaction between genotype and salinity hardening treatments improved vegetative (plant height, leaf area, fresh and dry weights of shoots) physiological growth parameters (TSS of the leaves, osmotic pressure, stomatal conductivity, transpiration rate and leaf temperature) and yield components (fruits number, total yield per plant and total yield per feddan), fruit quality (average fruit weight, TSS) and chemical content (total carbohydrates, total protein, ascorbic acid, Ca and Na) as well as chemical contents in the shoots (total N, P, K, Ca, Mg) and lowering Na, proline. Treatments proved that the best combination of treatments if the VT 737 hybrid treated with the medium level of salinity hardening of 3000 ppm followed by the same genotype treated with the high level of hardening of 4500 ppm. 7.2.3 The second order interaction between the fertilization and the salinity hardening:The interaction between fertilization and salinity hardening treatments improved vegetative (plant height, leaf area, fresh and dry weights of shoots) physiological growth parameters (TSS of the leaves, osmotic pressure, stomatal conductivity, transpiration rate and leaf temperature) and yield components (fruits number, total yield per plantand total yield per feddan), fruit quality (average fruit weight, TSS) and chemical content (total carbohydrates, total protein, ascorbic acid, Ca and Na) as well as chemical contents in the shoots (total N, P, K, Ca, Mg) and lowering Na, proline. Treatments prove that the best combination of treatments is the mono potassium phosphate with the medium level ofsalinity hardening of 3000 ppm.7.3. The third order interaction among the three studied factors: (Tomato genotypes, Fertilization and salinity hardening)7.3.1 The best interaction effects between the three studied factors can be summarized in the combination of the genotype of VT 737 hybrid treated with the medium salinity level of 3000 ppm and receiving the fertilization treatment of

mono potassium phosphate. The results brought about by the interaction of this combination of treatments were the highest in all measured parameters in vegetative (plant height, leaf area, fresh and dry weights of shoots) physiological growth parameters (TSS of the leaves, osmotic pressure, stomatal conductivity, transpiration rate and leaf temperature) and yield components (fruits number, total yield per plant and total yield per feddan), fruit quality (average fruit weight, TSS) and chemical content (total carbohydrates, total protein, ascorbic acid, Ca and Na) as well as chemical contents in the shoots (total N, P, K, Ca, Mg) and lowering Na, proline.7.3.2 In general, salinity reduced the contents of nutrients such as N (expressed as protein), P, K, Ca, Mg as well as chlorophyll contents while increased the contents of Na, TSS and proline.SumoiwifMeanwhile the effects of applied treatments either individual or their interaction reversed this results where the treatments increased the contents of N (expressed as protein), P, K, Ca, Mg as well as chlorophyll contents and decreased the contents of Na, TSS and proline.7.3.3 Generally all types of treatments interactions were significantly higher than the control treatment. But the interaction between hybrid V.T.737 and salinity hardening for seedlings with 3000 ppm using mono potassium phosphate in drip irrigation water 3gm/L, resulted was the best vegetative growth, physiological characters, chemical composition of the foliage and fruits and the yield and its component increased by 37.2% compared to control.