EFFECT OF SOME NUTRIENTS ON GROWTH AND YIELD OF COTTON UNDER SALINE CONDITION

BY

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B.Sc. Agric. Sci., Microbiology, Ain Shams Univ., 2010

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ABSTRACT

Amira Sadek El –Hosany Drwish: Effect of some nutrients on growth, yield and fiber quality of Egyptian cotton under saline condition. Unpublished M.Sc. Thesis, Department of Agronomy, Faculty of Agriculture, Ain Shams University, 2018.

Two pot experiments were carried out at the greenhouse of the Cotton Res. Inst., Agric. Res. Cent., Giza, Egypt during 2015 and 2016 seasons to study the response of cotton plant to application of some nutrients to improve the performance of cotton plant under irrigation of saline water to increase growth, yield and yield components and fiber quality of Giza 90 cotton cultivar. The experimental design was a split plot design with four replications. Main plots included saline water solutions treatments (control, 2000, 4000, 6000 and 8000 ppm), sub plot included four nutrients application (potassium humate, algex, poly ethylene glycol (PEG) 6000 and potassein compared with control). The obtained results could be summarized as follows: Plant height, total dry weight/plant, dry weight of bolls/plant and leaf area/plant significantly decreasing by increasing salinity levels at the three sampling dates 75, 90 and 105 days from planting in both seasons compared with the control. Nutrients application showed significant increase in plant height, total dry weight /plant, dry weight of bolls /plant and leaf area/plant at the three sampling dates. The plants which sprayed with PEG gave the highest averages of plant height and leaf area /plant at the three sampling dates and total dry weight / plant at 75 days only, while potassium humate gave the highest averages of total dry weight/ plant and dry weight of bolls /plant at the two sampling dates 90 and 105 day. The potassium humate, algex, poly ethylene glycol and potassein applications under normal and salinity stress conditions had positive effects on improving the performance of cotton plants, which increased plant vegetative growth traits especially under salinity stress conditions.

Irrigation with saline water over seasons significantly decreased plant height at harvest, number of fruiting branches/plant, number of open bolls /plant, boll weight, seed index, seed cotton yield per plant, fiber length, uniformity index, fiber strength and micronaire value, while, lint % was significantly increased. Nutrients application had significant effect on growth parameters, yield and its components and fiber properties under study, All nutrients treatments gave the highest values of growth parameters, yield and its components and fiber properties as compared with the control in both seasons. In general, plants sprayed with PEG gave the highest averages of plant height at harvest, number of fruiting branches/plant, while potassium humate gave the highest averages of yield and its components and fiber properties followed by plants sprayed with algex, while the plants sprayed with PEG as came the last in these respect in both seasons. Interaction between irrigation with slain water and nutrients application had a significant effect on plant height at harvest, number of fruiting branches per plant, boll weight, number of open bolls /plant, seed index, seed cotton yield /plant and fiber quality under study in both seasons. Plants treated with foliar nutrients under salinity condation scored the highest average of growth parameters, yield and its components and fiber properties. Potassium humate, algex, PEG and potassein applications to plants under normal and salinity conditions had positive effects on improving the performance of cotton plants, which increased plant growth, yield and fiber properties especially under salinity conditions.

Key Words: Cotton, Saline Water, Potassium Humate, Algex, Poly Ethylene Glycol, Potassein, Growth, Yield and Fiber Quality

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INTRODUCTION

Cotton known as the 'King of fiber' and called as the 'White Gold' is a major world fiber crop. It is grown under a very wide range of climates, soils and cultural practices. In Egypt, cotton is one of the most important crop for both local industry and export. Also, it is considered the main source of fiber and oil. Raising cotton production through increasing unit area productivity and the cultivated area contributes to economic production of the crop. Therefore, increasing cotton yield and reducing cost of production are essential aims for growers.

Water availability for irrigation could be enhanced through judicious and proper use of saline water and the recycling of drainage waters. Considerable amounts of such water are available in various places in the world. The development of crops by increased salt tolerance and the adoption of new crop and water management strategies will further enhance and facilitate the use of saline waters for irrigation and crop production, while keeping soil salinity from becoming excessive. Use of saline water for irrigation requires standard management practices including selection of appropriate crop, crop rotations, improvement in water as well as soil management and in some cases the adoption of advanced irrigation technology or/and improving the drainage conditions in the irrigated areas. Use of saline water in irrigation became an important goal for alleviating water scarcity in arid and semi-arid regions.

Humic acids use as complement to synthetic or organic fertilizers. In many instances, regular humic acids use will reduce the need for fertilization due to the soil and plant ability to make better use of it. About 9,000 macro algae species are classified into three main groups depending on the pigmentation including brown, green and red algae. More than 15 million tons of seaweeds are produced annually and used as bio-fertilizer in agriculture and also used human food, animal feed and row material for industry. Poly Ethylene Glycol (PEG) a non-penetrable and non-toxic osmotic lowers the water potential of the medium and has been used to simulate drought stress and PEG 6000 as pretreatment could improve salt tolerance in crops. Potassium is an essential macro-element required in large amounts for normal plant growth and development. Potassium is an important nutrient that has favorable effects on the metabolism of nucleic acids, proteins, vitamins and growth substances. Furthermore, Potassium plays important roles in the translocation of photsynthates, sugars and activation of many enzymes required from source to sink. From this knowledge we can using this martial to improve the performance of cotton plant under salinity condition.

The main objective of this investigation was to study the response of cotton plant to application of some nutrients under salinity condition to improve the performance of cotton plants and increase growth, yield and yield components and fiber quality of Giza 90 cotton cultivar.

REVIEW OF LITERATURE

I- Effect of salinity on cotton growth, yield and fiber quality:

Water availability for irrigation could be enhanced through judicious and proper use of saline water and recycling drainage waters. Considerable amounts of such water are used in various places in the world with applying of improved farming and management practices. Development of cotton crop genotype to increase salt tolerance and the adoption of new crop and water management strategies will further enhance and facilitate the use of saline waters for irrigation and crop production. Use of saline water for irrigation requires standard management practices including selection of appropriate cotton cultivars and crop rotations, improved water and soil management, adoption of advanced irrigation technology and improved drainage facilities in the irrigated areas. Use of saline water in irrigation became an important mean for alleviating water scarcity in arid and semi-arid regions.

Iyengar, *et al*. (1978) found that when cotton cv. IAN / 579 / 327 / 2749, IAN / 579 / 188 and SRT-3087 were grown under 0, 10000 or 15000 ppm sea water after transplanting, stem length and branch number/plant decreased with increasing salinity. Av. seed-cotton yield decreased from 31.2, 41.8 and 35.3 g/plant in the 3 cv. resp. under control conditions to 12.4, 26.4 and 19.7 g/plant with applications of 15000 ppm sea water. The highest salinity level reduced total number of flowers/plant due to increasing flower shedding. Total boll number/plant and the physical properties of lint fibers were unaffected by salinity treatment.

El-Gharib and Kadry (1983) pointed that when cotton cultivar Giza 75 was irrigated the by 0, 2000, 3000 and 4000 ppm plant height, boll weight, lint percentage and seed index were not affected by salinity. The number of open bolls/plant, seed cotton yield increased with increasing salinity.

Hajibagheri *et al.* (1989) stated that reduction in root and shoot development may be due to toxic effects of the salts used as well as unbalanced nutrient uptake by the seedlings. It may be due to the ability of the root system to control entry of ions to the shoot which is of crucial importance to plants survival in the presence of NaCl. Also, in field-grown cotton, irrigation with saline water was a major reason for seed abortion, leading to both yield loss and bad fiber quality

Brugnoli and Lauteri (1991) reported that when cotton and bean plants grown at different salinity concentration (0, 50, and 250 mM NaCl) in the medium, shoot dry weight and total leaf area were strongly reduced by salinity. Total leaf area was reduced by 35% in plants grown in 50 mM NaCl and by 60% in those grown in 250 mM NaCl, relative to control plants. But the growth of bean was more severely affected by salinity than cotton growth.

Abd-Ella and Shalaby (1993) study the response of cotton cv. Tamcot 788 to different salinity levels at different K:Na ratios of irrigation water in a greenhouse pot experiment. The salinity levels in irrigation water were 3200 and 6400 mg/litre with a control treatment of 320 mg/litre. K:Na ratios in irrigation water were 1:9 and 1:4. Increasing total salinity of irrigation water reduced seed yield and total DW of cotton but not number of total or open bolls. The lower K:Na ratio (1:9) had a beneficial effect on most yield components. Increasing salinity of irrigation water caused an increase in Na, but not K or Ca, content of cotton leaves, while decreasing K:Na ratio in the saline irrigation water decreased the K:Na ratio in the leaves. Lower leaf water potential (LWP) was associated with higher salinity and K:Na ratio. A strong relationship was found between cotton seed yield, LWP and K total bases content in leaves. Ionic content relations (K:Na and K:total bases content) were strongly associated with LWP. It was concluded that increasing K to a certain extent (K:Na of 1:9) could be useful in irrigating cotton with high water salinity. The beneficial effects of K additions to diminish salinity effects in cotton may improve plant water relations, as well as the status of ion relationships.

Ahmed (1994) In a pot experiment, cotton cv. Giza 83 was given 1 irrigation of saline water with 10000, 15000 or 20000 ppm NaCl at seedling, squaring or the start of flowering growth stages, followed by tap water irrigation. Saline irrigation water decreased plant height, number and length of internodes/plant, number of sympodia/plant, number of flowers and open bolls/plant, boll weight, seed index and seed cotton yield. The reduction in growth and yield increased with increase in salt concentration and was more pronounced with saline irrigation at the seedling stage. Seed oil content was decreased by saline irrigation, while protein, K and Na contents were increased.

Munk and Roberts (1995) studied eight Acala (*Gossypium hirsutum* L.) and four Pima (*Gossypium barbadense* L.) cultivars, revealed that plant height and number of fruiting nodes were reduced with increasing salinity levels ranging from 1.5 to 17.5 ds/m^{-1}.

Leidi and Saiz (1997) reported from study on two cotton cultivars (Paymaster 792 and Zaire 407/1157), growing under same salt concentration (200 mM NaCl), that salinity reduced the leaves stem and root growth of both cultivars when the highest NaCl concentration (200 mM), was applied.

Saeed, (2000) found that irrigation with saline water decreased significantly root length, plant height, number of fruiting branches, total number of flowers, total number of bolls, number of open bolls, boll setting % and boll opening % at both seasons. Boll weight, seed index, lint percentage and seed cotton yield per plant were also significantly decreased with saline water irrigation. Micronaire value was significantly decreased with increasing salinity of irrigation water, while fibre strength was not significantly affected in the two seasons.

Akhtar and Azhar (2001) compared response of 23 F_1 hybrids of *Gossypium hirsutum* L. using zero and high concentration of NaCl, they reported that the salinity caused significant reduction in shoot and root lengths.

Meloni *et al*. (2001) conducted an investigation on cotton (*Gossypium hirsutum* L) response to various salt levels (0, 50, 100 and 200 mol m^{-3}NaCl) their results showed a significant decrease in shoot, root and leaf growth biomass.

Ahmed *et al.* (2002) stated that the salinity imposes a major setback in increasing the yield of cotton due to reduction in germination, leaf area, stems thickness, shoots and root length and weight, biomass production and ultimately brings about decrease in seed cotton yield.

Bhatti and Azhar (2002) studied the responses of cotton(*Gossypium hirsutum* L.)to five NaCl levels(0, 75, 100, 125 and 150 mM) at seedling stage, they found that the application of NaCl solutions caused significant reduction in shoot and root lengths, but the effect was more pronounced on roots, where data revealed that root lengths were more seriously affected more than shoot lengths suggesting the sensitivity of root length to NaCl salinity.

Khafaga (2005) studied the effect of KCl concentrations (control, 1 and 2%,) as a foliar application and pre-sowing seed hardening treatments (tap water, 0.1% $ZnSO_4$, 0.25% CaCl, and dry seed as control) under two saline irrigation well water (3800 and 5750 ppm) on growth characters, yield and its components as well as fiber quality of cotton (*Gossypium barbadense*) cv. Giza 83. All the growth traits, yield and its components as well as fiber properties of cotton plant under slight saline irrigation well water were better than those grown under high saline one. The growth traits, yield and its components as well as lint qualities of cotton plant were significantly increased by the foliar application and seed hardening treatments under the two saline well water compared with the control. KCl at 2.0% and $ZnSO_4$ at 0.1% surpassed other foliar and seed