Effect of Foliar Spraying with Uniconazole and Micronutrients on Yield and Nutrients Uptake of Wheat Plants Grown under Saline Condition.

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Abstract: A Pot trial experiment conducted in the green house of National Research Centre, Dokki, Giza, Egypt to study the effect of foliar spraying with Mn., Fe. and uniconazole on photosynthetic pigments and yield as well as the chemical contents of the grains of wheat plants grown under saline condition. The results showed that salinity affects most yield parameters, i.e. plant height, harvest index, number of tillers and spikes/plant, spikes weight, weight of grains and straw/plant as well as the biological yield. However, it increases photosynthetic pigments content in the leaves and potassium concentration in the grains. Concerning the foliar spraying application with Mn and Fe or uniconazole, yield parameters and photosynthetic pigments were increased in the leaves, on the other hand, Macro nutrients (NPK) as well as micro nutrients (Mn. And Fe.) increased by foliar spraying. [Journal of American Science 2010;6(8):398-404]. (ISSN: 1545-1003).

Key words: Wheat, Salinity, Foliar spray, Mn, Fe, Uniconazole, photosynthetic pigment, yield, nutrients content.

1. Introduction:

Wheat is considered as the major cereal crop in the world in respect of the cultivated area and total production. It provides an almost 20 % of food calories for people in the world as well as in Egypt. Increasing wheat production is the ultimate goal to reduce the wide gap between production and consumption.

The limited available water resources represent the main limiting factor affects the agricultural development in arid and semi arid regions. Therefore, it is urgent to fined an alternative source of water for irrigation. The application of saline water in irrigation may be one of the most appropriate solutions. Wheat is generally classified to be moderately tolerant to salinity (1).

The effect of micro nutrient elements on yield and crop performance has been reported by many investigators. Rehm and Albert Sims (2) reported that, yields were higher for the treatments with micronutrients. In this respect, Singh (3) reported that, foliar sprays of ferrous sulphate or chelates are found to be more effective and efficient than soil application in correcting Fe-chlorosis in wheat. Nevertheless, the soil and foliar application of Mn significantly increased the yields, but the rates of soil applied Mn (40-50 kg ha-1) are uneconomical than its foliar sprays due to more reversion of soil applied Mn to higher oxide in alkaline soils.

It is well known that, salinity adversely affects growth and yield of crop plants through its effect on several aspects among them ion uptake (4). Thus, foliar application of nutrients via foliage is particularly preferable under such conditions where nutrient uptake from soil is restricted. This is often the case for Fe, Zn and Mn. These nutrients are frequently fixed by soil particles under saline conditions.

One of the recent techniques used to counteract or alleviate the injurious effect of salinity is by using growth retardants (5). One of these retardants is uniconazole. Wang-Xi *et al*., (6) found that uniconazole increased grain yield, yield components and rate of photosynthesis of rice plants. Imam *et al*., (7) reported that number of tillers, leaves, yield of wheat plants increased as affected by uniconazole under water stress conditions. Moreover, Uniconazole, as a potent and active member of the triazole family, was developed for use as plant growth retardant and is increasingly used to manipulate plant growth and yield.(8).

The objective of this study was to investigate the effect of foliar application of Mn and Fe individually or combined and uniconazole on growth, yield, and nutrient uptake of wheat plants grown under saline conditions

2. Materials and Methods:

Wheat grains (*Triticum aestivum*) C.v. Sakha 92 were sown in 25 cm diameter pots filled with clay loam soil**.** The physical and chemical properties of the used soil are presented in Table (1) using the standard method described by klute (9). Pots were divided into two groups one group irrigated with tap water and the second group irrigated with artificially salinized water by adding NaCl and $CaCl_2$ (in the ratio of 1:1 by weight) to obtain 4000 ppm concentration.

Three weeks after sowing , plants were thinned to three plants per pot .Soil in each pot received 3.74

gm ammonium sulphate (20.6%N) at a rate of 60 kg N / fad split into two equal doses applied at tillering and at onset of ear emergence (i.e. after 7 and 11 weeks from sowing). At tillering stage (after 7 weeks from sowing) each treatment of water.

Table (1): Some physico-chemical properties of soil

Properties	Items
Sand %	14.8
Silt %	37.0
Clay %	48.2
Texture	Clay loam
pH (1:2.5 soil : water)	8.16
E.C.(1:2.5 soil : water) dS/m	0.23
CaCO3 %	1.4
Organic matter %	2.05
Available Macronutrients (mg/100g soil)	
P	1.8
K	48.5
Mg	276
Ca	390
Na	22.2
Available Micronutrients (mg/ Kg soil)	
Fe	4.30
Mn	3.10
Zn	1.90
Cu	0.90

At tillering stage (after 7 weeks from sowing) each treatment of water irrigation were sprayed with water or one of the following aquas solutions containing 0.1% ferrous sulphate , 0.1% manganese sulphate .mixture of ferrous sulphate and manganese sulphate with the aforementioned concentration and uniconazole with concentration of 20ppm. Each pot represent one replicate.

Two weeks after foliar fertilization (13) weeks from sowing), representative sample from two replicates was taken from every treatment for photosynthetic pigments content determination in the flag leaf on the basis of leaf area (mg/ dm^2) and calculated by means of (10).

At harvest time , wheat plants were collected and the following characters were determined, number of tillers, number of spikes / plant , spike length weight of grains / spike, the yield of both grains and straw/ plant and weight of 100 grains.

Total nitrogen content in grains was determined using the method described by (11). Phosphorus was determined calorimetrically and potassium was determined using Flame Photometer according to the methods described by (12). Fe, Mn were determined by using Perkin Elemer Atomic Absorption Spectrophotometer.

The analysis of variance of split complete randomized design was used according to the method described by (13).

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3. Results and Discussion:

Effect on chlorophyll content

Data presented in Table (2) show that photosynthetic pigments (chlorophyll a,b, a+b and carotenoids content on basis of leaf area (mg/ dm2) increased by salinity as compared with unsalinized plants . These results confirmed by (14 &15). Such increase may be attributed to the inhibition of chlorophylase enzyme activity which is known to be responsible for synthesis and destruction of chlorophyll in plant tissue (16). It can be observed also from Table 2 that foliar spraying with different micro element singly or combined increased formation of chl. a, b and total chlorophyll as well as carotenoids comparing with control treatments under both saline or non saline conditions. .The positive effect of Fe on chlorophyll synthesis has been recognized. Fe is an essential nutrient element for plant growth and development and is involved in chlorophyll synthesis, thylakoid synthesis, and chloroplast development. Therefore, when the plant suffers from Fe deficiency, the newly forming leaves develop chlorosis symptoms (17 & 18).

The data in the same table also show that the highest chlorophyll a and b and total chlorophyll was obtained by foliar spraying with $MnSO_4$. Such promoting effect of Mn may be attributed to its effect as an activator of many different enzymatic reactions and takes part in photosynthesis (19). They also added that deficiency of Mn induces inhibition of growth, chlorosis and necrosis, and the structure of chloroplasts is markedly impaired. Our results were in harmony with those obtained by (20& 19).

Uniconazole treatment tended also to increase photosynthetic pigments content. This was achieved under saline or non saline conditions as compared with control treatment Table (2). These results were in harmony with those obtained by (21& 22) who recorded an increase in such pigments due to uniconazole treatment. Such increase of chlorophyll content may be attributed to earlier cytokinins formation which stimulate chlorophyll synthesis and production (23). In this respect, Izumi *et al* (24) reported that the application of uniconazole increased cytokinin levels in treated plants.

Regarding the interaction effect between salinity treatment and foliar spraying with Fe, Mn. and uniconazole on photosynthetic pigment content the data indicate that the interaction between saline irrigation water and foliar spraying with uniconazole slightly increased pigment content as compared with other interactions.

Table (2): Effect of foiar spraying with Fe , Mn. and uniconazole on Chl.a, b, a+b and carotenoids content (mg/Dm2) in the flag leaves of wheat plants grown under saline conditions

saline treatment	Foliar spray treatment	Chl. a	Chl.b	Chl. a+b	Carotenoids
saline water	control	3.34	1.43	4.77	1.93
	Mn	3.55	1.82	5.37	2.20
	Fe	3.48	1.75	5.23	2.20
	Mn. + Fe	3.35	1.63	4.98	1.98
	Uniconazole	3.55	1.55	5.10	2.00
tap water	control	2.77	1.18	3.95	1.84
	Mn	3.22	1.42	4.64	1.98
	Fe	3.18	1.38	4.56	1.92
	Mn. + Fe	3..00	1.28	4.28	1.88
	Uniconazole	3.14	1.33	4.47	1.94

Effect on yield and yield components

Data presented in Tables (3&4) indicate that irrigating wheat plants with saline water significantly decreased plant height and harvest index and highly significant decreased number of tillers/ plant, number of spikes per plant and spikes weight/ plant and drastically and very highly significant depressed weight of grains and weight of straw/plant as well as the biological yield as compared with non saline water. These findings coincide with those obtained by (25, 26 and 27). Such depressive effect of salinity in wheat growth may be attributed to the adverse effect on enzymatic processes through some interactions of salts and some organic substances of the cell (28). Moreover, crop reduction due to salinity is generally related to the osmotic potential increase of the root – zone soil solution which leads to certain phonological changes and substantial reduction in productivity (29). The observed reduction in grain yield under salt stress has been attributed to reduction in dry matter production through a feedback effect of photosynthesis during reproductive phase of growth (30).

Regarding, the foliar spraying with Fe or Mn as well as their mixture, increased most parameters of yield components but did not reached the levels of significance for plant height, tillers, spikes No. and spikes weight as compared with the control. However, it is significantly increased grains weight, straw weight, biological yield as well as harvest index. The more pronounced effect on increasing grain yield was recorded by wheat plants foliar sprayed with either Fe or Mn. and their mixture. The superiority of Fe on grain yield may be attributed to the indirect role of Fe in chlorophyll synthesis. In addition Iron enters in many plant enzymes that play a dominant roles in oxidoredox reactions of photosynthesis and respiration (18). The superiority of Mn. treatment resulted from the fact that Manganese (Mn), is regarded as an activator of many different enzymatic reactions and takes part in photosynthesis. Manganese activates decarboxylase and dehydrogenase and is a constituent of complex PSII-protein, SOD and phosphatase. Deficiency of Mn induces inhibition of growth chlorosis and necrosis, early leaf fall and low reutilization (31) concerning the effect of uniconazole on yield and yield components , the uniconazole followed the same pattern of Fe and Mn. but to some extent irrespective type of water irrigation. Such improving effect of uniconazole in improving grain yield may be attributed to its effect on photosynthesis, hormones and antioxidant system (8).

Regarding the interaction effect of water irrigation type and foliar spraying with Fe, Mn. and uniconazole, It is obviously clear that foliar spraying with the fore-mentioned microelements and uniconazole increased most of yield parameters under both types of water irrigation as compared with controls, However, plant height , tillers No., spikes No. and spikes weight records did not reach the level of significance. The highest grain yield was obtained by wheat plants irrigated with tap water and foliar sprayed with Mn. then followed by wheat plants irrigated with saline water and foliar sprayed with Fe.

Table (3): Effect of saline treatment and foliar spraying with Fe or Mn and uniconazole on yield and yield componants of wheat plants.

Treatments	Plant height	Number of tillers /plant	Number of spikes /plants	Weight of spikes /plant	weight of grains /plant	Straw yield/fed.(Ton)	Biological yield/fed.(Ton)	Seed index
Saline treatment								
saline water	74.88	3.38	3.36	13.01	8.61	13.09	21.71	40.07
Fesh water	80.84	4.16	4.04	15.50	9.45	15.92	25.38	37.44
F- test	*	**	**	**	***	***	***	*
Foliar spray treatment								
control	78.75	3.65	3.60	14.54	8.62	16.53	25.15	34.78
Mn.	81.75	3.85	3.85	14.76	9.58	14.31	2.88	40.96
Fe.	80.90	4.15	3.85	16.44	10.45	16.41	26.86	39.18
Mn. + Fe.	77.50	3.75	3.60	14.06	9.45	13.15	22.60	42.01
Uniconazole	70.40	3.45	3.60	11.47	7.07	12.15	19.21	36.84
L.S.D.	6.33	ns	ns	2.20	1.03	2.16	2.74	3.24

Table (4): Effect of interaction between saline treatment and foliar spraying with Fe , Mn. and uniconazole on yield and yield components of wheat plants

saline treatment	Plant height	Number of tillers /plant	Number of spikes /plants	Weight of spikes /plant	weight of grains /plant	Straw yield/fed.(Ton)	Biological yield/fed.(Ton)	Seed index
saline water	74.5	3.5	3.4	12	7.67	13.63	21.3	36.27
	77.6	3.2	3.2	12.29	7.47	9.82	17.55	44.16
	80.30	3.90	3.70	15.47	10.72	18.12	28.84	37.38
	74.30	3.50	3.20	13.93	9.98	12.12	22.10	45.35
	67.70	2.80	3.30	11.34	6.96	11.78	18.74	37.18
LSD								
non saline water	83.00	3.80	3.80	17.07	9.57	19.44	29.01	33.30
	85.90	4.50	4.50	17.24	11.42	18.79	30.21	37.75
	81.50	4.40	4.00	17.41	10.18	14.69	24.87	40.98
	80.70	4.00	4.00	14.19	8.92	14.18	23.10	38.67
	73.10	4.10	3.90	11.59	7.17	12.51	19.69	36.49
L.S.D. 5%	**ns**	**ns**	**ns**	**ns**	**1.45**	**3.05**	**3.88**	**4.59**

Effect on protein percentage and nutrients concentration in wheat grains:

Data presented in Table (5) shows an obvious decrease of N, P and K percentage as well as protein percentage in grains of wheat plants as a result of irrigation with saline water as compared with tape water irrigation. The results are in good agreement with those obtained by Murat *et al*. (32) who reported that application of NaCl caused a decreases in chlorophyll, N, K, Fe and Cu concentrations.

Such effect may be attributed to the effect of salinity on nutrient absorption. Under saline condition, nutrient absorption is restricted by lack of nutrients by small water potential in the rooting medium (33& and 34). May and Muna (34) also added that salt stress induced a significant decrease in protein content along with activity of nitrase in the developed seedlings. The observed decrease in K percentage might be related to the competition between the uptake of cations Na and K. Such

competition might be due to the existence of general carrier for their absorption by the roots (35).

The same table (5) shows decreases of Fe and Mn concentration in wheat grains under saline condition. These decreases may be due to the depressive effect of salinity on root growth and distribution in soil.

Regarding the uniconazole application data in table (5), increased the macro (N,P,K) as well as micro nutrients (Fe and Mn). In this concern, May and Muna (34) reported that such effect may be attributed to the effect of uniconazole in counter acting the adverse effect of salinity and significantly increased protein levels and stimulated nitrase reductase activity particularly at lower NaCl concentrations.

Regarding the foliar application effect of Fe, and Mn on macro and micronutrient content the same table show that N,P and K percentage as well as Fe and Mn greatly increased under both types of water irrigation as compared with control. These results were confirmed by the findings obtained by (35) .In this connection Erdal *et al*. (36) suggested that foliar application is an effective way to increase Fe concentrations in strawberry cultivars.

From the obtained results, it can be concluded that, the use of foliar spraying can alleviated the harmful effect of salinity on growth of wheat plants by foliar spraying with either Mn, Fe or uniconazole .

Table (5): Effect of foiar spraying with Fe , Mn. and uniconazole on N,P,K , Fe and Mn content of wheat grains under saline condition.

saline treatment	Foliar spray treatment	Total N %	P %	K%	Protein %	Fe ppm	Mn.ppm
saline water	control	1.89	0.21	0.043	10.868	94	6.0
	Mn	2.18	0.30	0.011	12.535	102	8.5
	Fe	2.29	0.38	0.012	13.168	144	7.4
	Mn. + Fe	2.38	0.49	0.015	13.685	146	10.1
	Uniconazole	2.38	0.45	0.017	13.685	197	10.0
tap water	control	2.08	0.25	0.015	11.960	104	7.0
	Mn	2.28	0.36	0.017	13.110	103	10.1
	Fe	2.38	0.39	0.019	13.685	197	9.2
	Mn. + Fe	2.59	0.45	0.020	14.893	201	11.0
	Uniconazole	2.49	0.52	0.021	14.318	221	12.0

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