Response of Wheat Plants to Seed Pre-Soaking in Hydrogen Peroxide Solution under Salt Stress Conditions

Mona G. Attia, Amal H. Mahmoud and Amira A. El-Araby[1]

ABSTRACT

Under arid and semi-arid condition of limited water resources, salinity is an important environmental constraint, affecting many crop productivity. The objective of this study is being suggested to examine the contribution of H_2O_2-presoaked seeds and salinity levels of irrigation water on growth and yield performance of wheat grown in different textured soils. To meet these objectives, the 3-way factorial experiment, comprising of 3 pre-soaking intervals (0, 24 and 36h), 3 different levels of saline irrigation water (500, 5000 and 8500 mg NaCl/L) was carried out in two different textured soils (sandy and clay soils), whereas wheat seeds were planted in cemented-bituminized plots (0.75 X 1.5 m) until the maturity stage. At tillering, random leaf samples were removed and analyzed for Na and K contents. At the harvest time, plant growth indices, including height and number of spikes/plot and yield components (straw and grain yields) were recorded.

The results have shown that plant growth characteristics and yield potentials were significantly suppressed with increasing the salinity stress of irrigation water, but the rate of decline varied considerably among all trails. The more depressive effects of the salinity exposure were clearly manifested on straw yield, being 74.6 and 85.6% at 5000 and 8500 mg NaCl/L, respectively. The pretreatment of seeds with H_2O_2 induced acclimation on the plants to salinity. It lessened the deleterious effect of salt stress on the growth of wheat especially when seeds were soaked in H_2O_2 for 36 h. This treatment caused relative increases in number of spikes /plot, grain yield, straw yield, defined by 44.5, 43.7, and 72.6%, respectively. Progressive results were achieved on all the studied plant criteria, giving better performance of the sand textured soil than the clay type. Superior wheat growth, maximum yield and highest K content were realized on wheat cultivated in sandy soil irrigated with saline water. Pretreatment of seeds with H_2O_2 for 24h induced acclimation of the plants to salinity. Moreover, seed priming with H_2O_2 for 36 h improved grain yield potentials and leaf K content in plants grown in sandy soil.

Key words: presoaking seeds – hydrogen peroxide – wheat – salt stress

INTRODUCTION

Soil Salinity and irrigation water quality are among of the most important variables affecting plant growth and yield potentials of different plant species and varieties (Mahajan and Tuteja, 2005). the data reported by FAO (2005) showed that 20% of the cultivated soil around the River Nile, is provided with good irrigation water quality. Besides, 2.1% of the agricultural dry-land prevailing in the new reclaimed area is dependent on different quality of ground water, as an alternative irrigation source. With subsequent and frequent surface irrigation, progressive accumulation of salts are being developed along the soil profile. Under poor drainage system and shallow water table, salinity problem is originated in medium and tine-textured soils, depending on the rate of water movement and environmental (Bauder and brock, 2001). In salt-affected soils, plant growth and crop productivity are seriously affected, because of the disruption of metabolic path-way and nutrional disorder (Silva, *et al*., 2008).

Salt stress exhibit different strategies in plants that allow them to overcome stress. It induces damage to plant cells catalyzed by reactive oxygen species (ROS) (Azevedo-Neto *et al.*, 2006). Plants have a complex antioxidative system to prevent the oxidative damage of ROS that involves both non enzymatic and enzymatic antioxidant defenses (Asada, 1999; Azevedo Neto et al., 2006). Hydrogen peroxide (H_2O_2) in plants is one of the major and the most stable ROS and regulates basic processes, such as acclimation, defense and development (Ślesak *et al*., 2007).Exogenous H_2O_2 can modulate root growth and development of plants under various stress condition and provide more intensive root system in wheat (Hameed et al. 2004).Hydrogen peroxide plays a dual role in plants as the toxic by-product of normal cell metabolism and as a regulatory molecule in stress perception and signal transduction (Wan and Liu 2008).

Previous reports have shown that seed priming could be used as a beneficial tool to induce quick germination, increasing growth character and yield performance (Gondim *et al*., 2010). In addition, it promotes the photosynthetic pigments content in the leaves, total carbohydrate percentage, as well as N, P and K contents in wheat grains as compared with untreated –seeds (Amin *et al*., 2008). Additional data (Gondim et al., 2012) revealed that seed priming with H_2O_2 increased the formation of antioxidants in seed, which play an important role in the seedlings emergency to counteract with the oxidative damage and stimulated the seedling

[1]Soil Salinity and Alkalinity Research Department; Soils, Water & Environment Research Institute; Agricultural Research Center (ARC), Alexandria, Egypt.
Received May 29, 2017, Accepted June 29, 2017.

growth under salt-stressed condition. Therefore, seed priming is considered a beneficial tool and is being used to ameliorate the stress tolerance in different crops (Ahmed *et al*., 2012).

In recent years, the role of H_2O_2 in plant acclimation is currently increased from different views. Thus, the aim of this study is being forward to test the contribution of hydrogen peroxide pretreatment of seeds on salt tolerance, yield performance and leaf Na and K content of wheat plants grown under salt stress conditions.

MATERIALS AND METHODS

This investigation was performed to test the effects of seed pretreatment with hydrogen peroxide on salt tolerance of wheat plants. The seeds of wheat variety Giza 168 were obtained from the Crop Research Institute, Agricultural Research Center (ARC) in Giza, Egypt and divided in two parts. The first part of seeds was soaked in H_2O_2 solution (100 mM.) for 24 and 36h. Later on, the seeds were washed with distilled water and then blot dried. The other part of seeds (non-soaked seeds) was used as the control.

The H_2O_2-soaked seeds and non-soaked seeds were sown in cemented- bituminized plots (0.75 X 1.5m) containing 2 different types of soil (sandy and clay) during the growing season 2013/2014. The initial chemical and physical properties of the two types of soil used and the tap water characteristics are given in table 1 (Page et al., 1982).

A factorial trait, comprising of 3 prepared saline irrigation water levels, i.e., 500 (S_0), 5000 (S_1) and 8500 (S_2) mg/L using NaCl, 3 soaking period (0, 24, 36h) and 2 types of soil (sandy, clay) were replicated 3 times in a complete randomized design. Plants were subjected to salt stress after sowing. Nitrogen and potassium were applied as ammonium nitrate and potassium sulfate fertilizers, at rates of 100 kg N/fed and 48kg K_2O/fed, respectively. The amount of N fertilizer was partitioned in 3 equal doses for N (at planting, 3 weeks later and before tillering stage), While K fertilizer was applied, in one dose, after 6 weeks of planting date. Phosphorus fertilizer was initially incorporated to the soil before cultivation at a rate of 45 kg P_2O_2/fed.

At maturity (May 2014), the plants were harvested and agronomic data including plant height, grain yield (GY), straw yield (SY) and number of spikes were recorded.

At tillering stage, random leaf sample were removed, washed, oven dried at 70 ^oC for 48 hr., weighed, and pulverized in stainless steel rotary Knife mill and stored in plastic bags. A portion of (0.5 g) oven dried leaf samples were completely digested with 5ml of H_2SO_4 conc. and hydrogen peroxide according to Evenhuis and De-Waard (1980).

Table 1. Soil and tap water characteristics

Characters	Soil		Tap water
	clay	sandy	
Soil pH (1:2 soil-water)	7.19	7.33	7.50
Soil EC (1:2 soil-water) (dSm^{-1})	1.84	1.29	0.78
Soluble cations (meq/L):			
Ca^{++}	6.86	3.95	3.20
Mg^{++}	3.70	1.42	1.75
Na^+	5.00	6.50	2.50
K^+	0.38	0.32	0.35
Soluble anions (meq/L)			
HCO_3^-	1.96	0.98	1.60
Cl^-	2.79	2.79	3.85
SO_4^{--}	11.19	8.42	2.30
Total $CaCO_3$ (%)	2.55	0.85	-
Total nitrogen (%)	0.15	0.06	-
Available phosphorus (mg/kg)	23.12	4.75	-
Available potassium (Cmole/Kg)	1.04	0.21	-
Organic matter (%)	2.37	0.14	-
Particle size distribution:			
Clay	42.9	2.00	-
Silt	19.2	3.00	-
Sand	37.9	95.0	-
Soil texture	clay	sandy	-

The clear digest was quantitatively transferred to 100ml volumetric flask. In this solution, the concentrations of Na^+ and K^+ were measured using flame photometer (JENWAY model PFP7/C).

The term "harvest index, HI %" is being introduced to relate the GY to total plant biomass. Accordingly, HI was calculated using the following relation:

HI (%) = {GY/ (GY+SY)} X 100

The obtained data were subjected to the analysis of variance (ANOVA) using CoSTAT (Co Hort, 1986). The significant differences among treatment means were evaluated on the basis of the calculated values of LSD (Duncan, 1965).

RERSULTS AND DISCUSSION

The analysis of variance (ANOVA) presented in table 2 revealed that the main variable effects and their interaction imposed significant trend on the most of selected traits at P≤ 0.05. To eliminate the diversion effects of the single and combined treatments on GY and SY performances, the term "harvest index percentage; HI %" is being introduced to relate the GY to total plant biomass.

1. Main treatment effects

1.1.Effect of saline irrigation water:

Irrespective to the effects of soil types and soaking period, the results in table 2 and figure 1 showed that the plants exposed to saline irrigation water imposed marked variations on the all recorded data. Taking the values of plant criteria at the control treatment (S_0, 500 mg NaCl/L) as a reference for the relative comparisons, the data revealed that the growth retardation, in terms of plant height, was depressed by 9.2 and 18.9%, when the salinity level of irrigation water was increased to 5000 and 8500 ppm, respectively. The inhibitory effects on the number of spikes/ plot were, subsequently declined to 59.51 and 68.7%, at the respective salinity levels. In the contrast, the leaf Na content (Fig. 1.c) was significantly increased by 19.5 and 30.1% accompanied by marked drop in leaf K content, defined by 24.6 and 42%, at S_1 and S_2, respectively. The calculated depressive effects on yield components at the highest salt level accounted for marked significant decrements, defined by 85.6, 74.3% for straw and grain yields, respectively.

Salinity stress reduces plant growth, alters ionic and osmotic effects and induces oxidative stress (Parida and Das, 2005). Crop performance may be adversely affected by salinity as a result of nutritional disorders.

Table 2. Analysis of Variance (ANOVA) for plant growth indices, grain and straw yield records and leaf chemical composition of wheat plants

SOV	df	Significant level: plant growth indices: Plant Height cm	Spikes No /plot	Grain & straw yield records: Grain yield g/plot	Straw yield g/plot	HI %	leaf chemical composition: Na %	K %
Blocks	2	ns	ns	ns	ns	ns	ns	ns
Main Effects								
soil types	1	**	*	ns	**	**	*	**
water salinity	2	**	**	**	**	**	**	**
soaking period	2	**	**	**	**	**	ns	ns
Interaction								
soil types X salinity	2	**	**	**	**	**	*	**
soil types X soaking period	2	ns	**	*	**	ns	**	**
salinity X soaking period	4	ns	**	**	**	**	**	**
soil types X salinity X soaking period	4	ns	ns	ns	**	*	**	*
Ms Error	34	20.87	191.97	2801.04	4209.6	0.004	0.035	0.033

ns= not significant at the 5% level **,*Significant at 1 & 5% levels, respectively HI= Harvest index

These disorders may derive from the effect on nutrient availability, competitive uptake, transport or partitioning within the plant (Silva *et al*., 2008). Besides, the osmotic effect involves limited water absorption due to the salt accumulation in the rhizosphere, exerting intracellular Na toxicity and nutrient imbalance (Silva *et al*., 2008).

1.2. Effect of soil type:

Regardless to the main effects of salinity level and soaking period, the results outlined on plant growth indices (plant height and spikes No. /plot), harvest index and leaf k content were progressively increased in the sandy soil as compared with the clay soil (Figure 2).

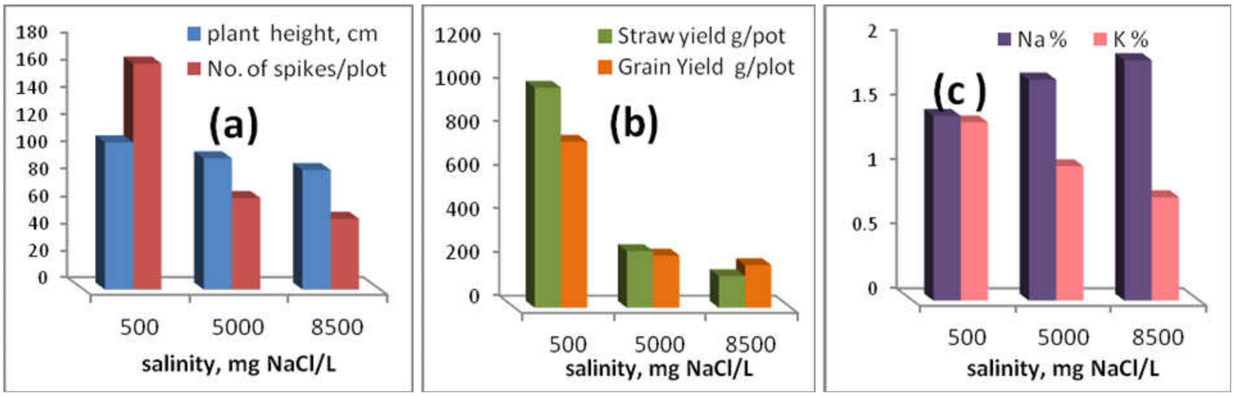

Fig.1. Main effect of salinity on plant growth indices (a), yield components (b) and leaf chemical composition of wheat plants

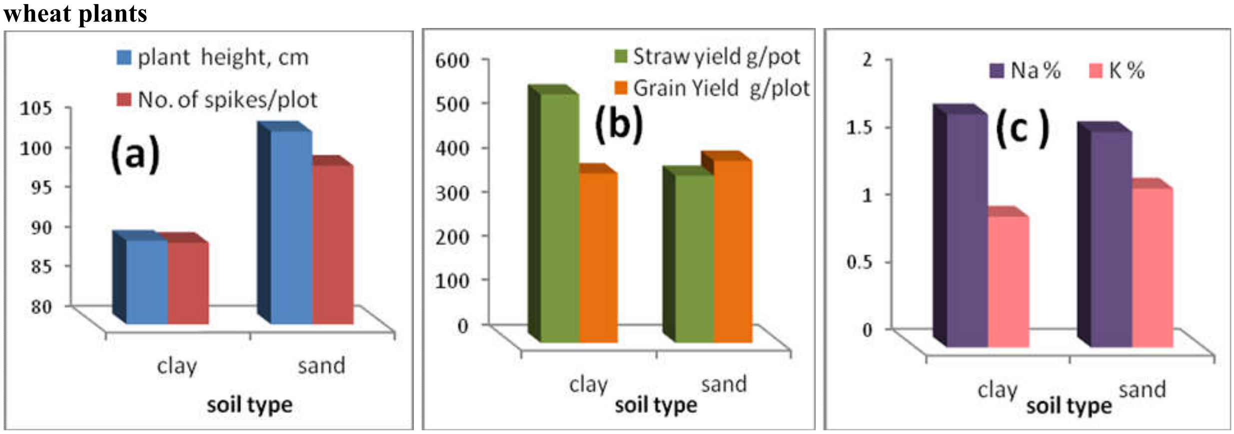

Fig. 2. Main effect of soil type on plant growth indices (a), yield components (b) and leaf chemical composition of wheat plants

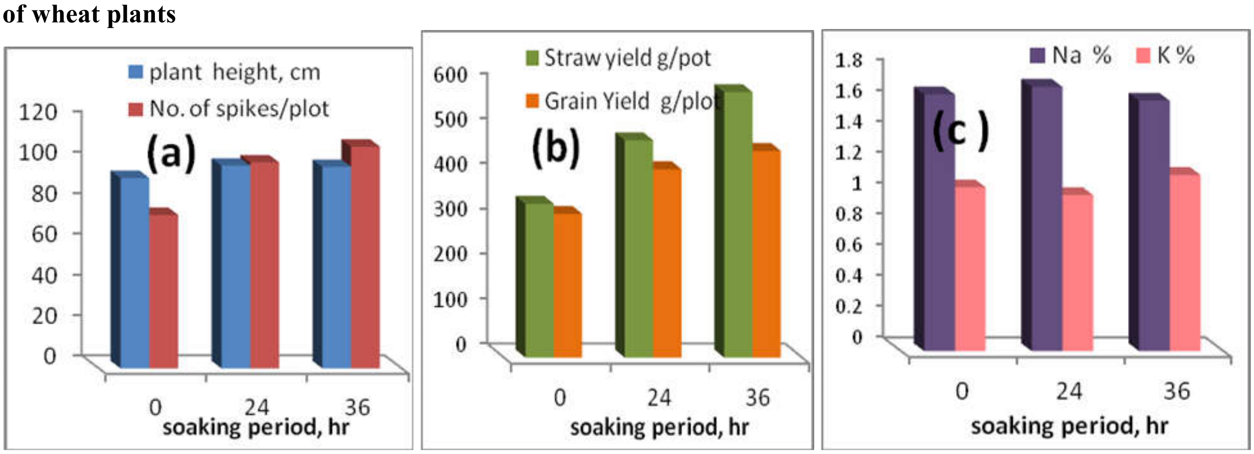

Fig. 3. Main effect of soaking period on plant growth indices (a), yield components (b) and leaf chemical composition of wheat plants

In contrast, straw yield and leaf Na content were significantly decreased in sandy soil as compared with the clay soil. The calculated relative increases in plant height, spikes number, grain yield, HI and leaf K content in wheat plants grown in the sandy soil as compared to the respective clay soil were defined by 15.2, 10.8, 7.3, 20 and 21.6%, respectively, accompanied by extensive drop in straw yield (32.7%) and Na content (7.5%).

These results would suggest that the hazarders effect of salt stress, originated from the frequent saline irrigation water on the growing plants was, partially, relevant (apparent) in clay rather than in sandy soils. This fact holds true because of the wide variations between the physical and chemical characteristics of the clay and sandy soils. In other words, the soil moisture retention, associated with short-term of Na exposure on rooting system and increasing soil porosity are among of the important facts that contributes for better yield performance in sandy soil.

1.3. Effect of soaking period:

With respect to the main effects of soaking period intervals on the studied criteria of wheat plants, the data in figure 3 showed that the pre-soaked seeds in H_2O_2 up to 36 h interval significantly increased plant height, number of spikes and K^+ content. The relative increments were 5.8, 44.5 and 7.5%, respectively, compared with unsoaked seeds. Besides, it induced marked significant increase in grain yield and straw yield defined by 43.9 and 72.6% respectively, associated with adverable effects in the HI leaf Na^+ content, defined by 16.4 and 2.4%, respectively.

The previous studies have shown that the H_2O_2–presoaked seeds of wheat increased antioxidative enzyme activity during germination, suggesting that germination is associated with enhanced cellular capacity to detoxify H_2O_2 (Cakmak *et al*., 1993). Additional data clarified that exogenous H_2O_2 treatment simultaneously enhanced multi resistance to heat, chilling, drought and salt stress in maize seedlings (Gong *et al*., 2001). Uchida et al. (2002) and Azevedo Neto *et al.* (2005) demonstrated that the pretreatment with H_2O_2 in nutrient solution induced acclimation to salt stress in rice and maize seedlings. In maize, Gondium *et al.* (2010) suggested that soaking seeds in 100 mM H_2O_2 solution for 36 h before germination in saline condition led to a salt stress acclimation process and reduced the deleterious effects of salinity on plant growth.

2.The 2-way interaction:

2.1.Salinity – soil type interaction

The data given in fig. 4 revealed that plant growth index, yield component and leaf chemical composition of wheat plants varied considerably among the two soil types along the salt stress exposure. However, superior growth, maximum yield (SY & GY), HI % and the highest K content in leaf were clearly evident on wheat cultivated in sand soil and irrigated with saline water of 5000 and 8500 mg NaCl/L. Opposite results were detected in the clay soil as compared with the sandy soil at the control treatments, whereas progressive and remarkable variations in tillering criteria and yield components were clearly manifested in clay soil. The LSD comparisons proved that the differences in all tested criteria between sandy soil and clay soil were significant at P=0.05 (Table 2).

The plants grown under field conditions often endure multiple stresses during their development. However, the vast majority of research has focused on individual stresses in the absence of others. Poor soil physical conditions may contribute for additional stresses in salt-affected areas (Grattan and Oster, 2003). For example, soils with poor structure or impermeable layers could restrict root growth as well as influence water and salt distribution in the soil. Crusting at the soil surface acts as a physical barrier for emerging seedlings and can lead to poor stand establishment particularly if the young seedlings are already weakened by salt stress. Generally, this interaction proved that soil texture is one of the determinal facts that affects the potential of nutrients supply for growth and yield performance under saline conditions (Bauder and Brock 1992 and 2001).

2.2. Salinity – soaking period interaction

Except the results detected on plant height criteria, the remaining traits imposed remarkable significant variation when the salinity level were increased, along the soaking period intervals of H_2O_2-treated seeds (Table 3). The data showed that at any given salinity level, growth vigorous, in term of plant height, was increased with the prolonged intervals of pre-soaked seeds in H_2O_2, accompanied with non-significant variation in growth criteria between the soaking period intervals (Table 3).

The results outlined on the number of spikes per plot showed that, only, at the control treatment (non-soaked seeds), the plant response to the increasing intervals of H_2O_2 – presoaked seed was clearly pronounced. This trend was, only, noticed, for the plants irrigated with wate of 5000 and 8500 mg NaCl/L at 24h H_2O_2-seed treatment (Table 3).

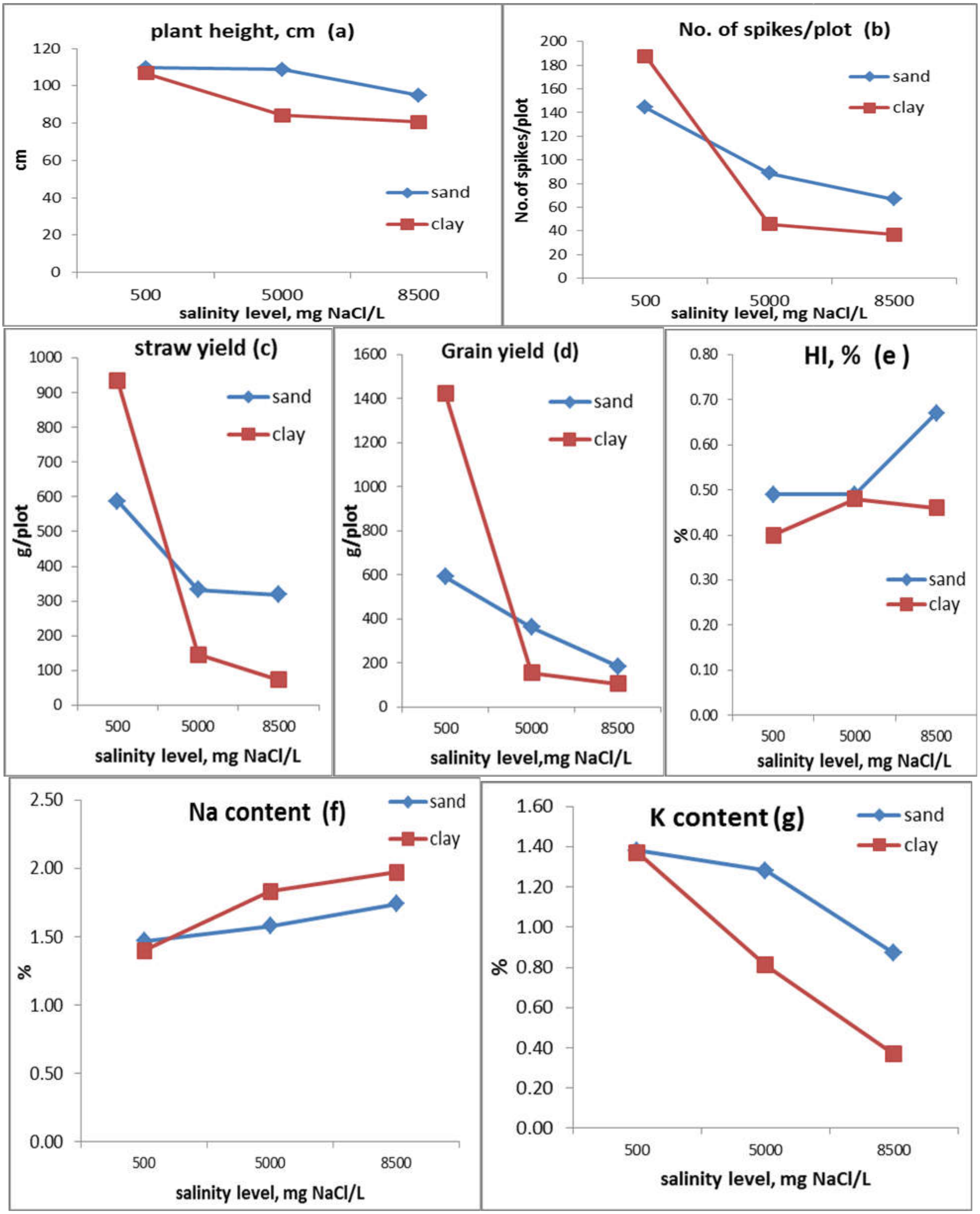

Fig. 4. Plant height (a), number of spikes (b), straw and grain yield (c & d), harvest index (HI) (e), leaf Na and K content (f & g) of wheat as influenced by the interaction between salinity level and soil types.

Table 3. Growth indices, yield components and leaf chemical composition of wheat plants in relation to the interaction effects of salinity and soaking period

treatments	salinity level, mg NaCl / L	soaking period, hr 0	24	36	LSD, 5%
	500	103.7	111.8	109.1	
Plant height, cm	5000	94.0	98.0	97.3	n.s
	8500	82.9	90.0	90.5	
	500	136.4	158.9	203.2	
No.of spikes/plot	5000	53.0	86.3	62.7	16.2
	8500	36.8	58.3	60.9	
	500	792.7	928.5	1301.6	
SY, g/plot	5000	187.1	336.9	253.5	76.0
	8500	44.1	180.4	211.8	
	500	581.7	771.4	928.9	
GY, g/plot	5000	203.4	271.6	243.1	62.0
	8500	171.7	210.6	203.3	
	500	0.42	0.47	0.45	
HI, %	5000	0.51	0.46	0.50	0.07
	8500	0.74	0.51	0.45	
	500	1.33	1.58	1.40	
leaf Na content,	5000	1.65	1.65	1.82	0.22
%	8500	2.02	1.90	1.65	
	500	1.20	1.70	1.23	
leaf K content,	5000	1.34	0.69	1.11	0.21
%	8500	0.66	0.64	1.10	

As for the soaking period prolonged to 36h., the number of spikes/plot was significantly dropped only at 5000 mg NaCl/L salinity treatment. At the highest saline irrigation water treatment, the variation was not remarkable. The data of the 2-way interaction proved that soaking treatment in $H_2O_2$for 24h was primitive to induce better results on the number of spikes/plot of wheat plants irrigated with water of 5000 mg NaCl/L.

As for the number of spike/plot records, similar trends were noted on straw and grain yields. The data in table 3 indicating that at moderate salt stress exposure, promising results could be realized when the wheat seeds are soaked in H_2O_2 for 24h.

Plants subjected to saline irrigation water acted to increase their Na content in leaves as the salinity level increased at each period of H_2O_2-pretreated seeds (Table 3). At any given treatment of seed soaking period, the differences in leaf Na content were significant at P≤ 0.05. At the low salinity level (5000 mg NaCl/L), the differences between leaves Na content along the all soaking treatment were statistically insignificant. This trend was also pronounced at the control treatment (irrigation water of 500 mg NaCl/L) whereas the calculated deviation between 24 and 36 soaking periods was not significant. Similarly, at the highest water salinity level (8500mg NaCl/L), the difference between non soaked seeds and 24h - presoaked seeds was not significant (Table 3).

Nonetheless, salinity stress reduced leaf K content as the salinity level increased at each period of H_2O_2-pretreated seeds (Table 3). At any given soaking seeds period, the differences in leaf K content were significant at P≤ 0.05. At the highest salinity level (8500 mg NaCl/L) the differences in leaf K content between the non-soaked treatment and 24h soaking period was not significant and soaked seeds for 36h caused significant increase in leaf K content as compared with the other traits (Table 3).

Wahid *et al.* (2007) reported that exogenous H_2O_2 improved salinity tolerance in *Triticum aestivum* when seeds were soaked in H_2O_2 (1– 120 µM, 8h) and subsequently grown in saline conditions (150mM NaCl). H_2O_2 levels in the seedlings, arising from H_2O_2- treated seeds,

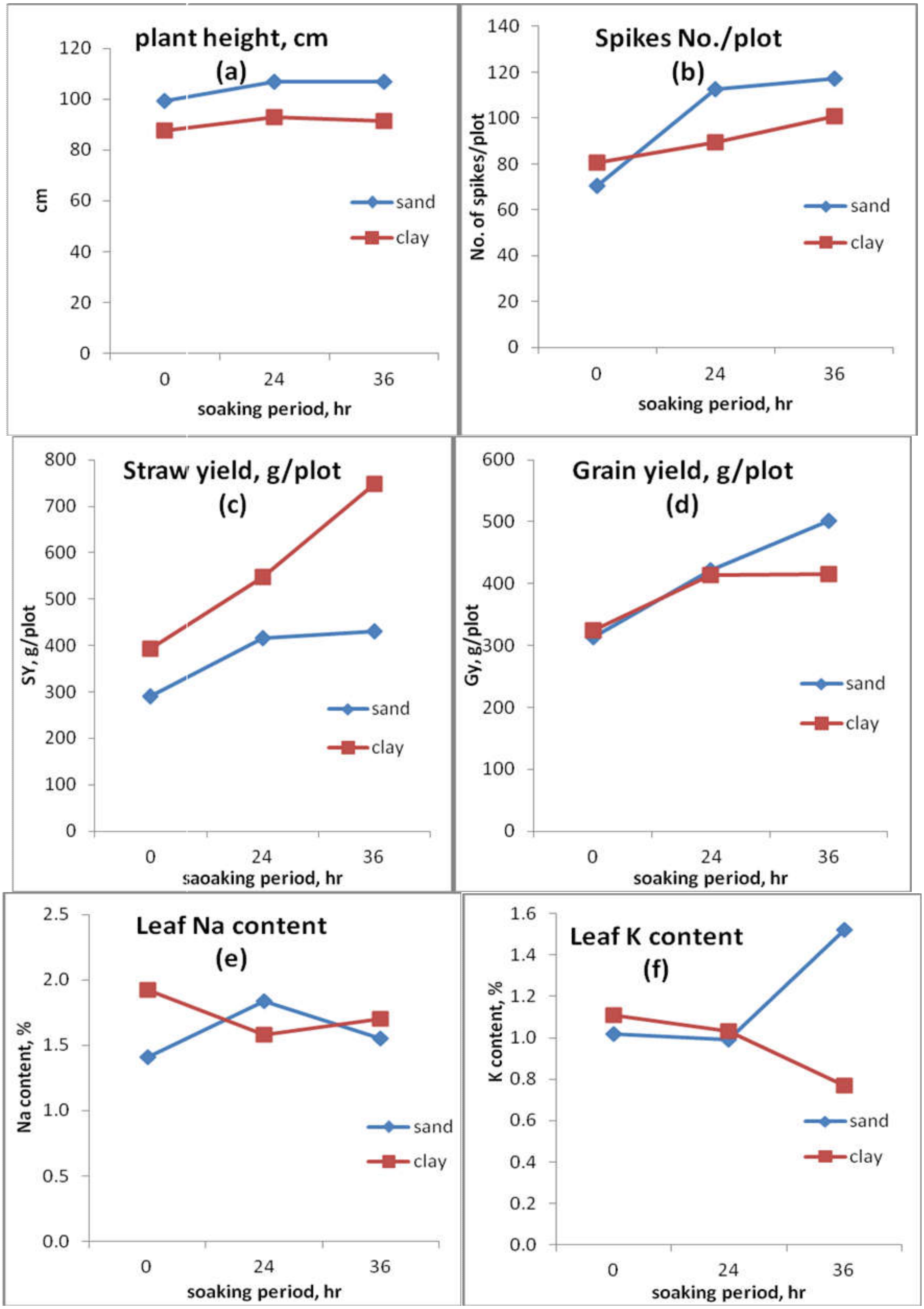

Fig. 5. Plant height (a), number of spikes (b), straw and grain yield (c & d), leaf Na and K content (e & f) of wheat as influenced by the interaction between soil types and soaking period

were markedly lower when grown under saline conditions than control seedlings from non-treated seeds with H_2O_2, and also exhibited better photosynthetic capacity. These results suggest that seedlings from H_2O_2-treated seeds had more effective antioxidant systems than that found in untreated controls. Moreover, the H_2O_2 treatment appeared to improve leaf water relations, stimulating turgor pressure, and improved the K^+: Na^+ ratio of salt stressed seedlings. H_2O_2 treatment also enhanced membrane properties, with greatly reduced relative membrane permeability (RMP) and lower ion leakage (Hossain *et al*., 2015). The above findings indicate that H_2O_2 metabolism might be important for the induction of salt tolerance. Li et al. (2011) reported that cellular defense antioxidant mechanisms were enhanced by the exogenous application of H_2O_2 in wheat seedlings under salt stress. Ashfaque et al. (2014) conducted an experiment to study the role of H_2O_2 in mitigating salt stress in wheat (*Triticum aestivum* L.) plants. Treatment of plants with H_2O_2 positively influenced plant growth under saline and non-saline conditions. The application of 50 or100 µM H_2O_2 reduced the severity of salt stress, with reductions in both Na^+ and Cl^- ion levels and an increase in proline content and in N assimilation.

2.3. Soil type – soaking period interaction

Irrespective to the effect of salinity, soaking seeds in H_2O_2 for 24 h or 36 h exhibited marked increments on plant growth parameters and yield components of wheat grown under the two different types of soil (Fig.5).

At any given soaking period, marked differences in plant height were clearly manifested between the two soil types, accomplished with greater performance in sandy than in clay soils (Fig. 5a). Because of the similar interaction trend, all the differences in plant height between the concerned soil types were not significant at $P \leq 0.05$

In sandy soil, the number of developed spikes / plot was successively enhanced, along the soaking intervals of seeds in H_2O_2, but the rate of response was relatively lower in clay soil than the counter clay soil. The different reaction between the selected soil types is presented in figure 5b, indicating marked deviations in this criteria, particularly at the 24 h soaking seed interval. The LSD comparisons showed that the difference in tillering index between the selected soils of the control treatment (non-soaked seeds) was not significant at $P \leq 0.05$. in contrast to the previous results, the data reported on SY data and presented in Fig. 5c revealed that wheat cultivated in clay soil exhibited greater dry matter yield along the entire soaking period than the sandy-textured soil. the LSD comparisons between the 2 different soil types revealed that wider deviations were existed, especially, at the 36 h pre-soaking period, (Fig. 5c) The results detected on GY clarified that there is no significant difference between wheat grain yields that cultivated in the two soil types at control treatment and soaking seeds for 24 hr in H_2O_2 solution (Fig. 5d). The data also showed that wheat cultivated in sand soil gives the highest significant grain yield when seeds soaked for 36 hr as compared with wheat cultivated in clay soil (Fig.5d).

The leaf mineral composition showed that Na content was relatively increased in plants grown in clay soil at zero and 36h soaking period as compared with sand soil. the LSD comparisons proved that such differences were only significant at $P \leq 0.05$ for the control treatment when seeds soaked for 24h in H_2O_2 solution, leaf Na content in plants cultivated in clay soil exhibited significant decrease as compared with sand one (Fig.5e).

Unlike the previous outlined trend on leaf Na content, the results documented on the effect of soaking period treatment on K content were quite different, revealing that plants cultivated in both soils exerted similar reaction with respect to their potentials supply at 0 and 24 h-soaking periods and the differences between the two types of soil were not significant. Subsequently, increasing soaking time to 36h imposed significant increase in K content in plants grown in the sandy than in clay soils (Fig. 5f)

From the above results we can concluded that, seed priming with H_2O_2 for 36h improve wheat performance, grain yield and leaf K content in plants grown in sandy soil as compared with the other treatments or the other soil.

DISCUSSION

Priming is potentially an important mechanism of induced resistance in plants against biotic stresses (Beckers and Conrath, 2007; Borges et al., 2014). Recent studies have shown that priming can also modulate abiotic stress tolerance (Filippou et al., 2012; Hossain and Fujita, 2013; Mostofa and Fujita, 2013; Borges et al., 2014; Wang et al., 2014a). Mounting evidence suggests that the initial exposure to chemical priming agents (such as H_2O_2, ABA, NO, SA etc.) renders plants more tolerant to abiotic stresses (Wang et al.,2010a; Hasanuzzaman et al.,2011a; Sathiyaraj et al.,2014). A number of studies on plants have demonstrated that the pre-treatment with an appropriate level of H_2O_2 can enhance abiotic stress tolerance through the modulation of multiple physiological processes, such as photosynthesis, and by modulating multiple stress-responsive pathways (Hossain and Fujita, 2013; Wang et al., 2014a). The above findings and our results demonstrate that H_2O_2 priming can induce tolerance to salinity in plants by modulating physiological and metabolic processes such as photosynthesis, proline accumulation and ROS detoxification, and that this ultimately leads to better growth and development. Moreover, priming treatments are being used to shorten the time between planting and emergence and protect seeds from biotic and abiotic factors during critical phase of seedling establishment which leads to uniform stands and improve yield (Afzal et al*.,* 2011).

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الملخص العربي

أستجابة نباتات القمح لنقع الحبوب في محلول فوق اكسيد الهيدروجين تحت ظروف الاجهاد الملحي

منى جميل عطية، أمل حسن محمود، اميرة احمد محمد العربي

تعد الملوحة من العوامل البيئية الهامة المؤثرة على انتاجية العديد من المحاصيل الزراعية في المناطق الجافة وشبه الجافة ذات الموارد المائية المحدودة. تهدف هذه الدراسة لاختبار مساهمة نقع الحبوب في محلول H_2O_2 وتطبيق مستويات من الملوحة باستخدام مياه ملحية في الري على نمو وانتاجية القمح النامي في نوعين من الاراضي مختلفة القوام. ولتحقيق هذا الهدف تم تصميم تجربة عاملية تتشكل من ٣ فترات نقع للحبوب (صفر، ٢٤، ٣٦ ساعة) مع الري بمياه ملحية ذات ٣ مستويات من الملوحة (٥٠٠، ٥٠٠٠، ٨٥٠٠ مجم NaCl/لتر) وزراعة الحبوب في نوعين من الاراضي مختلفة القوام (رملية، طينية). تمت زراعة حبوب القمح المعاملة في احواض اسمنتية مبطنة (٧٥ x١٥٠سم) وتطبيق ما سبق ذكره من معاملات حتى النضج. تم اخذ عينة عشوائية من اوراق القمح عند مرحلة طرد السنابل لتحليلها والوقوف على محتواها من الصوديوم والبوتاسيوم. وعند الحصاد تم تسجيل مؤشرات نمو النباتات(طول النبات، عدد السنابل/ حوض) وايضا مكونات المحصول (القش والحبوب).

اظهرت النتائج حدوث انخفاض معنوي في نمو النبات والمحصول مع زيادة الاجهاد الملحي لماء الري مع اختلاف معدل الانخفاض للصفات المدروسة. وكان التاثير الاكثر للملوحة على محصول القش حيث سجل معدل الانخفاض النسبي عن الكنترول ٧٤.٦، ٨٥.٦% عند ٥٠٠٠، ٨٥٠٠ مجم NaCl / لتر على التوالي. ولقد ساهمت معاملة الحبوب بالنقع لمدة ٣٦ساعة في محلول H_2O_2 في زيادة نسبية في عدد السنابل/ حوض ومحصول الحبوب والقش مقارنة بالكنترول(حبوب غير منقوعة) قدرت بـ ٤٤.٥، ٤٣.٧، ٧٢.٦% على التوالي. كما اظهرت النتائج نمو افضل للقمح النامي في الارض الرملية مقارنة بالارض الطينية. كما تميز القمح المنزرع في الارض الرملية تحت الاجهاد الملحي بنمو افضل ومحصول اعلى ومحتوى اعلى فى البوتاسيوم في الاوراق عن نظيره النامي في الارض الطينية تحت نفس الظروف. كما اوضحت النتائج ان نقع الحبوب لمدة ٢٤ ساعة في محلول H_2O_2 هي الافضل معنويا تحت ظروف الاجهاد الملحي بينما النقع في نفس المحلول ولكن لفترة ٣٦ ساعة هي الافضل فى محصول الحبوب ومحتوى الأوراق من البوتاسيوم عند زراعة القمح في الارض الرملية.