Effect of NaCl Salinity on Growth Parameters and Some Physiological Characteristics of Wheat *Triticum aestivium* L.

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Abstract:

This study was conducted in the year 2020 in the fields of faculty of agriculture and marshes - University of Thi-Qar, to understand how NaCl affects certain growth parameters and physiological traits of wheat plants. This study was conducted in field conditions with water salinity levels using six concentrations of NaCl (0, 25, 50, 75, 100 and 125) m.mol. The results revealed that NaCl salinity at high concentrations increased the Na ion content in the leaves and carotene content of the plant, while decreasing the plant height, leaf area, bio mass/ plant, total chlorophyll. relative water content of leaves and K: Na ratio, this study showed that the wheat plants were tolerant of Na Cl salinity stress to certain limit (50 m.mol).after this caused the reduction of many growth and physiological traits due to the accumulation of Na ions in plant cells.

Key words: Salinity stress, NaCl, Growth, Physiological parameters, Wheat.

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Introduction

Wheat is one of the oldest, most important grains in the world. The most vital is (Triticum aestivum L.), some wheat is used with the aid of industry for the manufacturing of starch, dextrose, gluten, alcohol, and other products. Soil saltiness is portrayed as high attention to solute salts which incorporates Na , Ca2 , and Mg2 in soils, causing bigger than four dS/m for soil electric conductivity, which is indistinguishable from 0.2 MPa of osm otic serviceable delivered with the guide of 40 mM sodium chloride (NaCl) in the arrangement (Rengasamy, 2002). Soil saltiness is a most significant gamble to horticulture as an end outcome of abiotic stress.Significant crop misfortunes take region yearly because of poisonous salts in soil, extraordinarily sodium chloride (NaCl).

Whenever vegetation are troubled with NaCl, they regularly display more slow development, untimely leaf senescence, brought down culturing or stretching, and decreased yield. Na is exceptionally impeding in inordinate focuses in the cytosol of leaf cells, as Na disrupts metabolic strategies like photosynthesis. Therefore, some vegetation have created resilience components to stop sped up centralizations of Na in cytosol in leaves. The three most indispensable components are tissue resilience, osmotic resistance and ionic exclusion. To avoid yield misfortunes due to soil saltiness. The aim of this study to become aware of the poisonous outcomes brought about by way of sodium chloride salt in plant cells, and what is the effect of the accumulation of sodium ions and the dangerous effects that are reflected in the physiological characteristics the wheat plant in general, and determine what salt concentration the wheat plant can tolerate.

Material and Methods

Preparation of soil and the experimental factors

This study was conducted in the fields of the Faculty of Agriculture and Marshes - University of Thi-Qar in 2020 using pots of 2 kg containing 2 peat moss: 1 sand, physical-chemical properties of the ground as follows:

pH	O.M %	E.C milimos. $^{cm-1}$	C.E.C meq/100 g soil
7.4	.67%	8.13	1.48

This study examined the concentration of sodium chloride salt at 6 levels also (0, 25, 50, 75, 100 and 125) m.mol.the wheat seeds were planted at 5 seeds per pot, the seeds were watered with the nutrient solution alone until the completion of the germination process.the completion of early plant growth.Two weeks after the date of cultivation, the treatment was performed with the nutrient solution added to the salt concentrations.About 70days after the date of cultivation, the following measures were taken:

Physiological parameters

K^+ and Na^+ ions estimation in the leaves

The sample and the acid were then placed in suitable containers and sealed and heated using a microwave, and the temperature of each container was increased to 160±5°C for a period not exceeding For 6 minute, it was left at this temperature for 10 minutes to finish the digestive process.then the contents filtered using a centrifuge and analysed with the inductively coupled plasma mass spectrometer.

Total chlorophyll

Total carotene content of leaves.

The total chlorophyll in the leaves of the wheat plant was determined according to (Withers et al.,1978). About (0.5) gm of plant leaves crushed by a ceramic mortar containing 80% acetone until the green color of the leaves was removed.the concentrate was sifted and the absorbance was estimated involving a spectrophotometer at a frequency of 663 nm for chlorophyll an and 645 nm for chlorophyll b, then the all out chlorophyll was determined:

Total chlorophyll (mg/L)= (20.2*D645) + (8.02*D663)

Carotene content =

Relative water content of leaves (RWC)

The relative water content of the leaves was determined after isolation and taking their fresh

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weight (FW) directly using a sensitive balance, then they were cut into pieces (5-10) cm and placed in test tubes containing distilled water and left in darkness for 4 hours, after the samples were extracted, the water from the samples was disposed of using filter paper The weights were measured again which represent their weight upon saturation (turgid weight) (TW) and then their dry weights (DW) were calculated after drying with an electrical oven at 70^{0}C for 48 hours, the relative water content was estimated from the following equation:

"RWC= (*(FW - DW)/ (TW – DW))* 100*"

Statistical Analysis

All samples were treated in triplicate and their averages were computed, statistical analysis of this experiment was completed using SPSS software (version 20).A one-way ANOVA was used for data analysis and significance was identified at $P \leq 0.05$. Data were expressed as mean with standard error ± SD (Bryman and Cramer, 2012).

Results and discussion

The results of the variance analysis showed significant differences (p<0.05) in growth traits such as plant height fig(1), leaves area fig(2), biomass fig(3), chlorophyll fig(4), carotene fig(5), relative water content fig(6), Na^+ content fig(7), K^+ content fig (8) and K:Na ratio fig (9), affecting by different levels of NaCl concentrations. The results of this study showedthat the NaCl salinity caused decreased values gradually with increasing the concentration of NaCl in growth parameters such as plant height, leaves area, biomass, chlorophyll pigment and carotene in leaves of the wheat plant, relative water content, K^+ content and K:Na ratio where the control treatment gave the highest ranges in most of these traits (18.33 gm, 2.71 $mg.g^{-1}$ FW, 0.31 $mg.g^{-1}$, 70.31%, 2.20 mg.g-1, 15.33%) for the biomass, chlorophyll, carotene content, relative water content, K^+ content and K:Na ratio respectively, while the lowest values of these traits found at the highest concentration of NaCl (125 m.mol) (6.51gm, 1.70 $mg.g^{-1}$ FW, 0.14$mg.g^{-1}$ FW, 53.12%, 1.23 $mg.g^{-1}$ DW, 0.57%) for the biomass, chlorophyll, carotene, relative water content, K^+ content and K:Na ratio respectively.The correlation analysis between those traits and NaClconcentrations showed that significant negative correlation (p<0.05) (r= -0.999*, r= -0.998*, r= -0.996*, r= -0.998*, r= -0.999*, r= -0.998*, n=3), respectively.

The results of present study showed that the NaCl salinity caused increasing values gradually with increasing the concentration of NaCl in Na^+ioncontent which gave (0.20 $mg.g^{-1}$ DW), while the lowest value of Na^+observed at control treatment (0.12) $mg.g^{-1}$ DW, the correlation analysis between Na^+ ion and NaCl concentration showed significant positive correlation (p<0.05) (r= 0.999*, n=3).

There were significant differences among the various physiological traits studied, such as plant height, leaves area, biomass, chlorophyll, carotene content and relative water content as well as other traits under stress conditions, as similarly reported by partially in line with our results (Zheng et al. 2009).

The reduction in wheat growth traits may want to be due to CO2 exchange parameters that have been viewed an vital indicator of plant increase as a end result of their direct relationship to the productivity (Piao et al.2008), as well as the discount in standard gas change and closure of leaf stomata could be due to poisonous Na and Cl ions which minimize the transport of photosynthetic electrons with reduced carbon absorption and metabolism and oxidative harm to PSII under NaCl stress, this could lead to nutrient imbalance due to the fact

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of the opposition in absorption and toxicity in plants, the discount of all growth traits, our results are constant with (Azizpour et al. 2010) &(Ashraf et al. 2012).

Kumar et al. (2008) and several experiments have indicated that the antagonism between K and Na absorption happens on the floor of the root below salinity stress. A low ratio of K :Na below the excessive concentration of NaCl possibly indicated that Ca 2, K , and Mg 2transportes were impaired via Na ion underneath heigh awareness of NaCl, this might also intervene with plant metabolism and reduce plant growth traits, the results of this study are comparable to different researchers (Munns and Tester 2008).

The groupings of (K , Ca and Na) and their proportions (K :Na and Ca2 :Na) are dependable valuable and extensively involved evaluating boundaries for sorting vegetation fundamentally founded on their resilience to NaCl poisonousness.

The height ratio of Na^{+}:K^{+} affected by high concentration of salt stress was confirmed by many studies,these specialists demonstrated that salt- lenient blossoms created a higher dry weight than the salt-delicate genotype underneath saline pressure conditions (200 mM NaCl) and more prominent resilience has been connected with higher K:Na proportion in plant leaves (Sarduie et al 2010) and (Tavakoli et al. 2010).

Chl is one of the most important chloroplast for photosynthesis, due to it harvests the light and produces reducing powers; however, Chl is susceptible to salt stress and may affect plant yield and quality (Giunta et al. 2002).

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The findings of the current chlorophyll and carotene had been regularly consistent with study of Ghogdi et al. (2012). Hence, it can be inferred that wheat with a higher chlorophyll content under saline effect is supposed to deliver more prominent increment attributes and yield than wheat with a lessening Chl content, for instance, settling on soils in light of expanded or secure Chl content material may furthermore hinder yield misfortunes under saline stress conditions.

Mahlooji et al. (2018) observed a positive relationship between chlorophyll content or different increase traits and plant performance with salt concentrations and vegetation with greater chl content material may additionally supply an index for higher increase qualities and grain yield, which is similar to our study.

High uptake of Na ions under saline conditions may alter water uptake and therefore reduce the range of RWC the decrease in R.W.C may be due to water reduction, leaf production, and increased senescence and abscission of leaves, it was perceived that resistance in wheat planting relies not just upon a ratio of k:Na, but additionally on avoiding accumulation of Na in the ethereal parts of plants, our results attention to that these physiological traits ought to be key elements and advantageous instruments for screening many examples in a concise timeframe and outfit useful information about pressure resistance systems.

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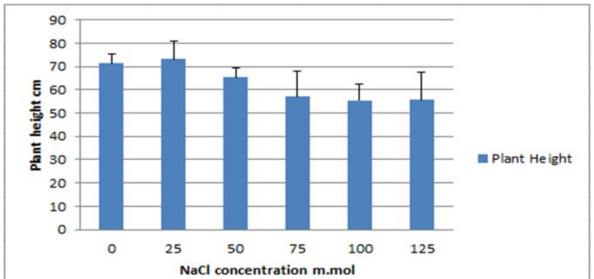

Fig 1

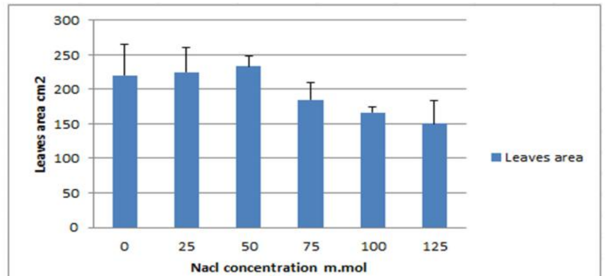

Fig 2

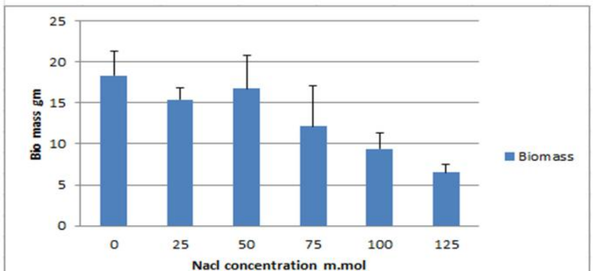

Fig 3

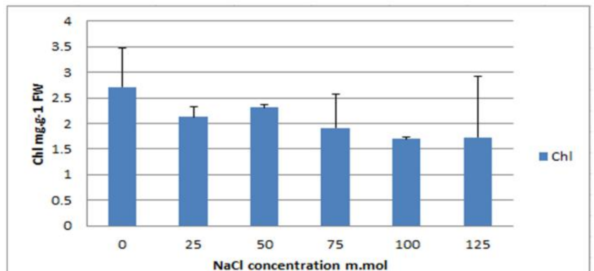

Fig 4

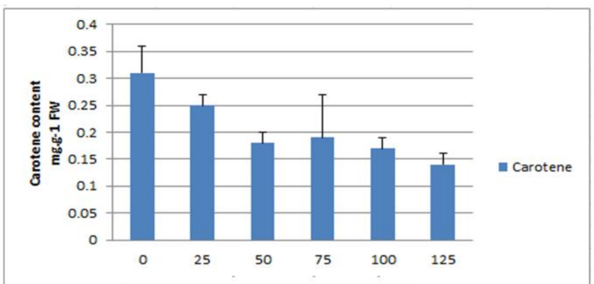

Fig 5

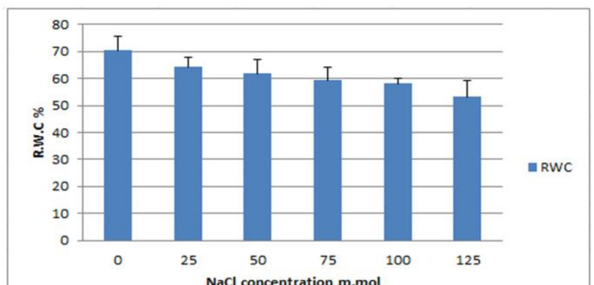

Fig 6

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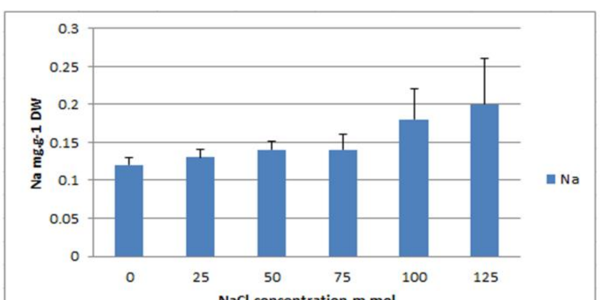

Fig 7

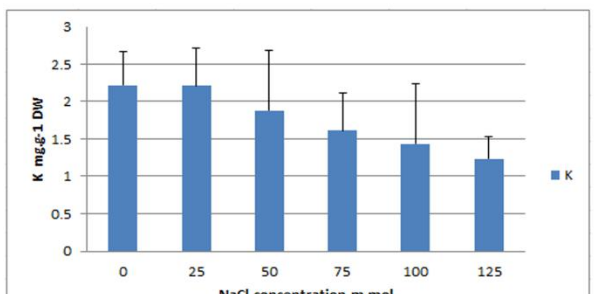

Fig 8

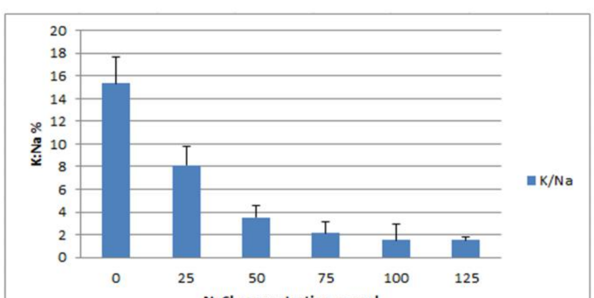

Fig 9

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Conclusion

This study revealed a significant negative effects occurred by using salt irrigation water, this salinity or increasing Na ion in plant cells caused reduction in growth traits of wheat plant because of effected on the water relationships of plant tissues and the tolerance of wheat plant highly depends on the ratio of K^+:Na^+ .

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