Response of Wheat Grown on Alluvial and Calcareous Soils to Potassium Fertilization under Saline Irrigation Water

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ABSTRACT

Greenhouse experiment was conducted to study the effect of saline irrigation water and potassium fertilizer on soil salinity and wheat (Triticum aestivum L.) cultivar were grown on two soils. The irrigation water salinity, EC_w were 0.61, 4.69, 9.38 and 14.06 d Sm^{-1}. The K-fertilizer rates were 0, 1.0, 2.0, 3.0 and 4.0 g pot^{-1} as K_2SO_4. Wheat cultivar, Giza 168 was grown to maturity on alluvial and calcareous soils. Soil properties, wheat yield and yield components were determined and statistically analyzed.

The results revealed that the increase in EC_e of alluvial soil to 5.74,11.48 and 16.95 dSm^{-1} was almost proportional to the EC_w of 4.69, 9.38 and 14.06 dSm^{-1}, respectively compared with an initial ECe of 1.97 dSm^{-1}. With calcareous soil, the corresponding ECe values were 5.98, 11.96 and 18.58 dSm^{-1} for the ECw of 4.69, 9.38 and 14.06 dSm^{-1}, respectively compared with an initial EC_e of 2.05 dSm^{-1}. A quantitative approach with linear regression revealed that the slopes were 1.13 and 1.17 for alluvial and calcareous soil, respectively.

The results indicated that wheat grain and biological yield significantly decreased as salinity was increased. The decreasing percent of grain yield over the control treatment were 18.29, 45.55 and 57.07% for EC_w 4.69, 9.38 and 14.06 dSm^{-1}, respectively. The corresponding values of the biological yield were 16.74, 36.09 and 46.37%, respectively. However, the 100–grains weight was not affected by salinity EC_w to 4.69 dSm^{-1} (4.45g) then followed by a reduction to 3.83 g as EC_w increased to 14.06 d Sm^{-1}. The same trend was also obtained for the yield components: spikes numbers and spikes weight per pot were being reduced by 41.75 and 48.46 %, respectively at the ECw of 14.06 dSm^{-1}. Such dropping was significantly varied within K fertilizer rates. Average all over salinity and soil types, the K fertilizer rates 3.0 and 4.0 g/pot gave maximum response for Giza 168 grain yield. The same trend was also obtained for the biological yield and the yield components. However, the differences between 3.0 and 4.0 g/pot were not significant for all studied characters.

With respect to soil types, wheat produced more grain in clay than in calcareous soil, being 33.93% greater while biological yield was 30.68%. The 100–grains weight was significantly not affected by soil types. The results indicated that the potassium– use efficiency(KUE) reached the highest value (6.43) at the fertilizer rate of 3.0 g/pot. Average all over soil types and at control salinity treatment, increasing the K level from 1.0 to 2.0 g /pot brought an increasing in KUE from 4.25 to 6.40 whereas decreased to 4.46 by the further increasing of K level to 4.0 g /pot. At salinity 4.69 dSm^{-1}, the KUE was obviously appreciably greater than at high salinity. The KUE values at 3.0 g /pot level reached 5.20, 4.86 and 3.99 for 4.69, 9.38, and 14.06 dSm^{-1}, respectively. This general pattern of yield –K response was found to modify according to salinity and maximum permissible of EC_w should not exceed than 4.69 dSm^{-1} to offset soil degradation and to obtain the economical productivity of wheat.

Key words: alluvial and calcareous soil, K-efficiency, K-fertilizer, water salinity and wheat cultivar.

INTRODUCTION

Maximizing the production of salt affected soils through fertilizer application is a necessity to provide adequate food for the present population. Wheat is one of the important cereals for human consumption and is grown under irrigation and rainfall in Egypt. In some areas, due to deficiency in supplies of high quality water, the use of any available water, including drainage or saline waters, become necessary. Such area is expected to include soils vary in their salinity level which may affect the growth and yield of crops. Since the saline water has been proposed as alternative irrigation source for wheat, attention should be drawn to its positive and negative effects on yield potentials and salinity status.

The inhibitory effect of salinity on plants as a consequence of high salts concentration level has been attributed to water deficit, salt toxicity, or nutritional imbalance (Bernstein and Hayward, 1958). Under such conditions, sodium adversely affects potassium supply to the plants (Pearson and Bernstein, 1958; Mustafa *et al.*, 1966 and Balba and El Etreiby, 1980). Potassium has a significant role in plant physiology as a cofactor or activator for many enzymes of carbohydrate and protein metabolism and as a stomata osmotic regulator, (Helal *et al.*,1975, El Sheweikh,1980 and El-Haddad and O'Leary, 1994, El Sayed et al., 1996, Moussa, 2000 and Magda and El-Mahgoby, 2006). Helal *et al.*, (1975) and Hylton *et al.*, (1967) reported that the addition of K to the root medium of barley and rye grass was found to reduce the harmful effects of high Na. Results of Storey and Wyn Jones (1978) on barley showed a decrease in potassium of the shoot and root tissues when plants were subjected to sodium chloride stress. The response of

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plants to potassium differs according to plant species and salinity levels and the ratio of K/Na. Dvorak *et al.*, (1994) pointed out that the K /Na ratio is one of the factors responsible for the higher salt tolerance in wheat.

However, salinity as a factor depresses progressively the yield of wheat, which is consequently rated as salt tolerant among other field crops. The data obtained by Richards (1954), Gawish *et al.* (1999) and El- Etreiby, (2002) indicated that wheat is generally considered to be moderately tolerant to salt. Under any case, salinity hazards are present because of arid condition and supplementary irrigation, (Massoud *et al.*, 1989). Moreover, potassium as an essential plant nutrient and soil salinity are factors have among other factors a greet effect on soil productivity. Information about these two factors potassium and salinity are very important for yield production of salt affected soils. The objective of this study was, therefore, to study the effects of irrigation water salinity and potassium application on the soil salinity and wheat production grown on alluvial and calcareous soils.

MATERIALS AND METHODS

A green house experiment was conducted at the Soil Salinity Lab., Alex., on two soils with wheat grown to maturity, the first soil represents an alluvial soil (*Torrifluvent*), while the second represents a desert calcareous soil (*Calciorthids*). Soil samples were taken, air-dried and the soil paste extract was analyzed for pH, EC_e and soluble cations and anions according to Richards (1954). Organic carbon, total $CaCO_3$ and total N were determined as mentioned by Black (1965). Mechanical analysis was carried out (Day, 1965) and indicated that their samples composed of 25.0 % sand, 32.5 silt and 42.5 % clay and 62.0% sand, 15.4 % silt and 20.6% clay and their textural group was clay loam and sandy clay loam, respectively. The total N in the alluvial and calcareous soil was 0.22 % and 0.09%, respectively. The main chemical characteristics of the two studied soils are given in Table (1).

Experimental Procedure:

Wheat (*Triticum aestivum* L.) cultivar Giza 168 was planted on Dec. 8, 2004 and Nov. 29, 2005 in pots. Each pot, 33 cm in diameter and 29 cm deep, was filled with 26 kg of soil. Three weeks latter, thinning was conducted to 5 seedlings/pot until maturity. A uniform application of P-fertilizer at the rate of 6.49 kg P feddan^{-1} was added at planting in the form calcium super-phosphate (6.54% P). Nitrogen in the form of NH_4NO_3 (33.5%N) at rate 74.40 kg N feddan^{-1} was applied into three parts, 20 % prior to sowing, 40% at the first post-emergence irrigation and again 43 days later. The K fertilizer treatments were at the rates of 0, 1.0, 2.0, 3.0 and 4.0 g K-fertilizer pot^{-1} as K_2SO_4 (39.84% K), which correspond to 0, 16.2, 32.3, 48.5, 64.64 kg K feddan^{-1}. All other recommended cultural practices were applied.

Thirty days after planting, the saline waters treatments were initiated in amount equal to field capacity plus that required achieving leaching fraction of 20% to avoid salt accumulation in the pot. The saline waters treatments were 0.61, 4.69, 9.38 and 14.06 d Sm^{-1}. At harvest, wheat biological (straw + spikes weight) and grain yields (g /pot), spikes numbers/pot, 100 grains weight (g) and spikes weight/pot (g) were recorded. A mathematical approach was used to calculate the slope of polynomial and exponential regression equations described the effect of K-fertilization and salinity of irrigation water on wheat production. Nitrogen– use efficiency, in terms of yield produced per applied potassium unit was estimated. The treatments were arranged in a complete randomized design and replicated three times. The results obtained were statistically analyzed using the pooled data over the two seasons by using personal computer according to Dagnelie (1975).

RESULTS AND DISCUSSION

Soil Salinity

Table (2) and Fig. (1) illustrate the effect of saline irrigation water having EC_w of 4.69, 9.38 and 14.06 dSm^{-1} on the average final EC_e of alluvial soil that increased to 5.74, 11.48 and 16.95 dSm^{-1}, respectively compared with an initial EC_e of 1.97 dSm^{-1}. With calcareous soil the salinity (ECe) reached 5.98, 11.96 and 18.58 dS.m^{-1} for the water containing 4.69, 9.38 and 14.06 dSm^{-1}, respectively compared with an initial EC_e

Table 1. Main chemical characteristics of the investigated two soils.

Soil	EC dSm^{-1}	pH	Total $CaCO_3$ %	soluble anions(cmol$_c$.L^{-1})				soluble cations (cmol$_c$.L^{-1})				SAR
				$CO_3^=$	HCO_3^-	Cl^-	$SO_4^=$	Ca^{++}	Mg^{++}	K^+	Na^+	
Alluv.	1.97	7.50	2.41	--	2.59	11.33	5.66	4.18	3.07	0.36	12.05	6.33
Calc.	2.05	8.22	32.10	--	2.70	11.80	5.90	4.35	3.20	0.37	12.55	6.46

of 2.05 dSm^{-1}. This increase was almost proportional to the EC_w of irrigation water, agreed with the values obtained by Singh and Narain (1980), El-Haddad *et al.* (1993), Sobh *et al.* (1997), El Etreiby *et al.* (2002) and El Ashtar, (2004). In other words, particularly for soil salinity, linear regression was definitely the more suitable to describe the increase of EC_e as functions of saline irrigation water EC_w.

$$Y_{alluv} = 0.936 + 1.127X \quad 061 \leq X \leq 14.06 \quad R^2 = 0.997 \qquad (1)$$

$$Y_{calc} = 0.999 + 1.167X \quad 0.61 \leq X \leq 14.06 \quad R^2 = 0.998 \qquad (2)$$

Where, X is the EC_w (dSm^{-1}). $Y_{alluv.}$ and Y_{calc} are EC_e (dSm^{-1}) for alluvial and calcareous soils, respectively.

The positive slopes of the previous equations confirmed the harmful effect of salt stress in irrigation water on soil salinity. The slopes were 1.13 and 1.17 for alluvial and calcareous soil, respectively. With this saline water concentration, wheat growth would be affected; therefore, EC_w of irrigation water should not exceed 4.69 dSm^{-1}. Repeating soil flooding with free drainage should be practiced in highly saline soils only. The use of saline water, EC_w = 9.38 dSm^{-1} in irrigated agriculture can not be sustained without periodic application of chemical amendments to offset this degradation and to enhance optimum plant growth and soil productivity.

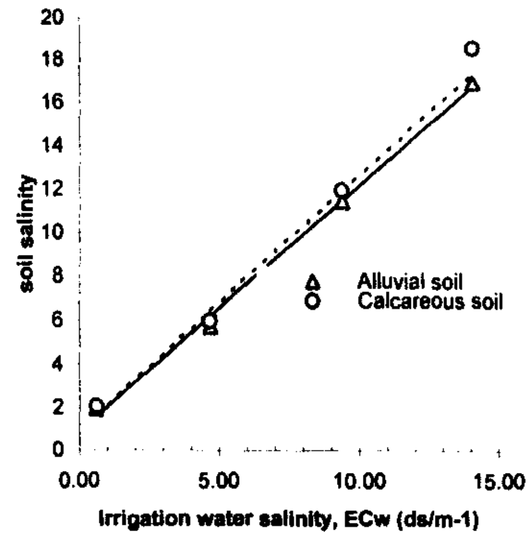

Fig.1. Soil salinity of the studied soils as a function oof irrigation saline water

Effect of salinity EC_w on wheat yield

As shown in Table (3), averaging the results from the K fertilizer rates and soil types, salinity in irrigation water significantly reduced all studied traits. At salinity of 14.06 dSm^{-1}, the decreasing compared with control was 57.07% for grain and 46.37% for biological yield. Reduction was markedly less for biological than for grain yield. According to the slopes of equations (3) and (4), the reduction of grain: biological ratio was 1: 0.72.

Table 2. Main properties of the two studied soils as affected by irrigation water salinity after crop harvesting.

EC_w	EC_e	PH	Soluble Cations				Soluble Anions				SAR
-- dSm^{-1} --			meq/l								
			Ca^{++}	Mg^{++}	K^+	Na^+	CO_3	HCO_3^-	Cl^-	SO_4^{--}	
						Alluvial					
0.61	1.97	7.50	4.18	3.07	0.36	12.05	--	2.59	11.33	5.66	6.33
4.69	5.74	7.60	8.75	7.08	0.57	39.75	--	2.62	47.27	6.25	14.13
9.38	11.48	7.63	10.66	9.36	0.63	70.91	--	2.88	91.78	20.15	29.76
14.06	16.95	7.70	14.45	13.25	1.40	139.50	--	3.17	137.95	27.36	37.48
						Calcareous					
0.61	2.05	8.22	4.35	3.20	0.37	12.55	--	2.70	11.80	5.90	6.46
4.69	5.98	7.98	10.75	9.30	0.49	39.23	--	2.73	49.24	7.80	12.39
9.38	11.96	8.21	13.30	9.36	0.66	95.90	--	2.88	91.78	20.21	28.25
14.06	18.58	8.23	19.20	10.85	1.34	144.05	--	4.73	139.67	41.39	37.16

Table 3. Mean values of different characters of wheat Giza 168 cultivar a affected by soil type, K fertilizer rates and saline water treatments

Factors	Characters				
	Grain yield (g /pot)	Biological weight (g/pot)	100 grains weight (g)	Spikes No./pot	Spikes weight (g/pot)
Soil type					
Alluvial	55.96a	122.08a	4.20a	26.45a	91.17a
Calcareous	36.97b	84.62b	4.25a	16.48b	59.07b
$L.S.D_{0.05}$	3.22	6.65	0.15	1.15	4.56
K -Fert.(g/pot)					
0	41.28d	100.42c	3.91d	19.83d	67.08c
1.0	45.31cd	111.54bc	4.10cd	20.83ab	72.08bc
2.0	49.95bc	112.29bc	4.23bc	21.63ab	74.17bc
3.0	51.63ab3	116.67ab	4.38ab	22.20ab	78.29ab
4.0	56.64a	125.83a	4.52a	22.83a	83.86a
$L.S.D_{0.05}$	5.09	10.52	0.23	1.82	7.21
Salinity (g/l)					
0.61	70.18a	150.73a	4.55a	28.50a	102.50a
4.69	57.34b	125.50b	4.45a	22.77b	81.00b
9.38	38.21c	96.33c	4.08b	18.00c	64.13c
14.06	30.13d	80.83d	3.83c	16.60c	52.83d
$L.S.D_{0.05}$	4.56	9.41	0.21	1.63	6.45

However, the 100–grains weight was not affected by salinity EC_w of 4.69 dSm^{-1} (4.45g) then followed by a reduction to 3.83 g as EC_w increased to 14.06 d Sm^{-1}. Younes *et al*. (1995) and El Etreiby (2002) reported similar results.

The same trend was also obtained for the yield components: spikes numbers and spikes weight per pot were being reduced by 41.75 and 48.46 %, respectively at the ECw of 14.06 dSm^{-1}. The exponential equation was used to express the grain and biological yield as a function of saline irrigation water EC_w:

$$Y_G = 74.237 \exp(-6.543 E\text{-}02 * X) \quad 0.61 \le X \le 14.06 \quad R^2 = 0.989 \quad (3)$$

$$Y_B = 154.829 \exp(-4.737 E\text{-}02 * X) \quad 0.61 \le X \le 14.06 \quad R^2 = 0.994 \quad (4)$$

Where, Y_G and Y_B are the grain and biological yield (g/pot) and X is the EC_w, (dSm^{-1}). The slopes are confirmed that reduction was markedly less for biological than for grain yield.

Effect of K –fertilizer on wheat yield

Averaging all over salinity (EC_w) and soil type treatments, the grain and biological yield were increased with increasing K fertilizer rates. The increasing per cent of grain yield over the control treatment were 9.76, 21.00, 25.07 and 37.21% for 1.0, 2.0, 3.0 and 4.0 g K/pot, respectively. The corresponding values of the biological yield were 11.07, 11.82, 16.18 and 25.30 %, respectively. The biological yield was much less affected by K-fertilizer rates than grain yield.

On average soil type, Table (4) and Fig. (2) Illustrate that as salinity increases response curve occupies a lower position; indicating that salinity was the main retarding factor to growth. .In other words, the response of grain yield to K application at the four EC_w was expressed as polynomial regression.

$$Y = 57.37 + 8.92X - 0.96X^2 \quad \text{at control} \quad R^2 = 0.95 \quad (5)$$

$$Y = 49.58 + 3.06X - 0.27X^2 \quad \text{at } EC_w \text{ } 4.69 \text{ } dSm^{-1} \quad R^2 = 0.98 \quad (6)$$

$$Y = 30.28 + 2.72X - 0.58X^2 \quad \text{at } EC_w \text{ } 9.38 \text{ } dSm^{-1} \quad R^2 = 0.99 \quad (7)$$

$$Y = 25.44 + 2.99X - 0.012X^2 \quad \text{at } EC_w \text{ } 14.06 \text{ } dSm^{-1} \quad R^2 = 0.98 \quad (8)$$

Where Y is grain yield (g/pot) and X is the K-application in (g $pot.^{-1}$).

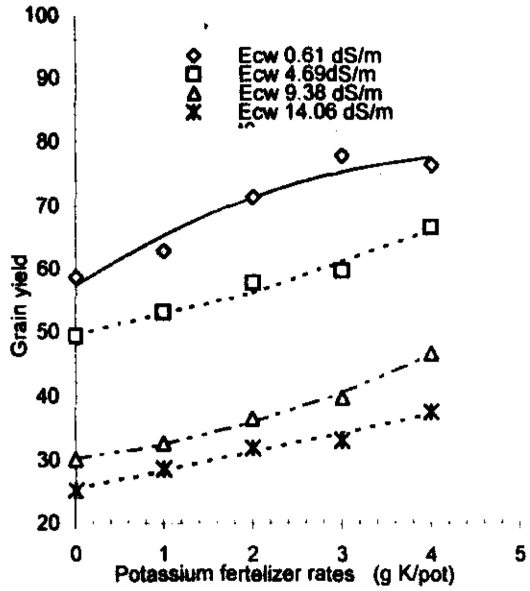

Fig. 2. Effect of K fertilizer and irrigation water salinity average all soil type on wheat grean yield.

The slopes of the previous equations revealed that the efficiency of K fertilization was reduced as salinity increased.

Soil type

On average K- fertilizer rates and salinity (Table 3), wheat produced more grain in alluvial than in calcareous soil, being 33.93% greater while biological yield was 30.68%. The 100–grains weight was significantly not affected by soil types. Perhaps and most probably the alluvial soil meets fully the nutritional requirements for grain formation as it is more rich in nutrients than calcareous soil. The same trend was also obtained for all studied traits and significantly differed except the 100–grains weight.

Potassium– use efficiency under salinity stress

Potassium– use efficiency (KUE), in terms of yield produced per applied nitrogen unit under salinity stress was estimated by $(Y_r - Y_c)/N_r$

Where, Y_r is yield obtained from K treatments, Y_c is yield obtained from control and N_r is applied potassium rates. The grain yield and K– use efficiency is presented in Tab. (4).

The potassium– use efficiency (KUE) reached the highest value (6.43) at the fertilizer rate of K fertilizer 3.0 g/pot. Average all over soil types and at control salinity treatment, increasing the K level from 1.0 to 2.0 g/pot brought an increasing in KUE from 4.25 to 6.40 whereas decreased to 4.46 by the further increasing of K level to 4.0 g/pot. At low salinity (4.69 dSm^{-1}), the KUE was obviously appreciably greater than at high salinity. The KUE values at 3.0 g /pot level reached 5.20, 4.86 and 3.99 for 4.69, 9.38, and 14.06 dSm^{-1}, respectively. The same technique using the polynomial regression was used to describe the effect of K fertilizer

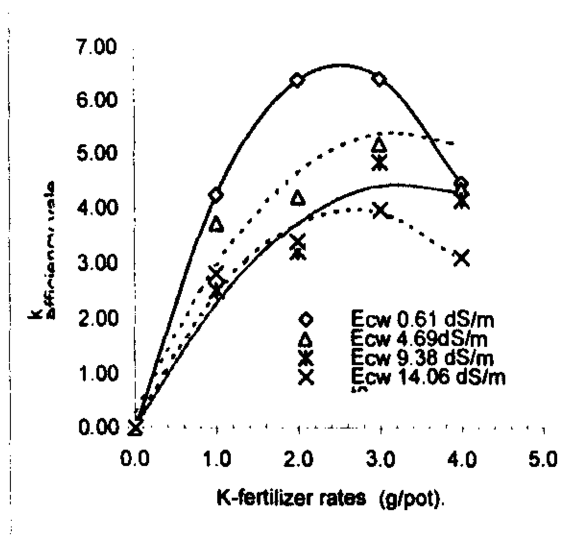

Fig.3. Potassium fertilizer efficincy as affected by K rates and irrigation water salinity

Table 4. Effect of K-fertilizer rates and EC_w with average all over soil type on the mean grain yield and potassium use efficiency (KUE).

Water salinity, EC_w (dSm^{-1})	Grain yield (g/pot)					K-Efficiency				
	K-fertilizer rates					K-fertilizer rates				
	0	1	2	3	4	0	1	2	3	4
	g K/pot					g K/pot				
0.61	58.60	62.85	71.39	77.90	76.42	0	4.25	6.40	6.43	4.46
4.69	49.34	53.08	57.77	59.74	66.73	0	3.74	4.22	5.20	4.35
9.38	30.15	32.65	36.60	39.86	46.77	0	2.51	3.23	4.86	4.16
14.06	25.20	28.69	32.01	33.18	37.66	0	2.82	3.41	3.99	3.11

rates at four salinity levels on KUE and the four lines were assumed to have the same intercept on the yield axis.

$Y= 0.0 +5.27 X - 1.04 X^2$ at control $R^2=0.99$ (9)

$Y= 0.0 +3.12 X - 0.48 X^2$ at EC_w 4.69 dSm^{-1} $R^2=0.95$ (10)

$Y= 0.0 +2.64 X- 0.39 X^2$ at EC_w 9.38 dSm^{-1} $R^2=0.96$ (11)

$Y= 0.0 +2.86 X- 0.53 X^2$ at EC_w 14.06 dSm^{-1} $R^2=0.97$ (12)

This general pattern of yield -K response was found to modify according to salinity and maximum permissible of EC_w should not exceed than 4.69 d Sm^{-1} to offset soil degradation and to obtain the economical productivity of wheat.

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الملخص العربي

أستجابة القمح للتسميد البوتاسي مع الرى بمياه ملحية

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أجري هذا البحث فى صوبه زجاجية فى موسمين متتالين لدراسة تـأثير الرى بمياه ملحية مع معدلات التسميد البوتاسي على ملوحة نوعين من الأراضي (طينية طميية وجيرية) و أنتاجية القمح. واشتملت الدراسة على خمس معدلات من البوتاسيوم: بدون اضافة، ٢,٠، ١,٠، ٣,٠و ٤,٠ جم /برميل وأربع تركيزات من مياه الرى الملحية ECw هى مياه الصنبور، ٤,٦٩، ٩,٣٨ و١٤,٠٦ ديسى سيمنز/ م. تم زراعة الصنف جيزة ١٦٨ حتى النضج وخصص لكل معاملة ثلاث مكررات . قدرت خواص الأرض و اخذ محصول الحبوب ومكوناته وعولجت النتائج بالطرق الإحصائية.

أوضحت الدراسة أن تأثير ملوحة مياه الرى واضح على ملوحة نوعى التربة حيث ان الزيادة فى التوصيل الكهربي (ECe) للأرض الطينية إلى ٥,٧٤، ١١,٤٨و١٦,٦٥ ديسى سيمنز/ مكانت دائما متلازمة مع ECw ٤,٦٩، ٩,٣٨ و١٤,٠٦ ديسى سيمنز/ م على التوالى مقارنة ١,٩٧ ديسى سيمنز/م. وكانت القيم المقابلة للتوصيل الكهربي (ECe) للأرض الجيرية هى ٥,٩٨، ١١,٩٦و١٨,٥٨ على التوالى مقارنة ٢,٠٥ ديسى سيمنز/م. . وأيضا بينت الدراسة الكمية لمعادلة الخط المستقيم للعلاقة بين ECw لمياه الرى أو ECe للأرض الطينية الطميية والجيرية أن الميل كان ١,١٣ و١,١٧ على التوالى.

وأظهرت نتائج الدراسة أن زيادة ملوحة مياه الرى أدت إلى انخفاض معنوى فى محصول الحبوب ومكوناته و الوزن البيولوجي .حيث أنخفض محصول الحبوب بالنسبة لمعاملة المقارنة بمقدار ١٨,٢٩، ٤٥,٥٥ و ٥٧,٠٧ % عند قيم ECw المستخدمة ٤,٦٩، ٩,٣٨ و١٤,٠٦ ديسى سيمنز/ م على التوالى. وكان الانخفاض المقابل فى الوزن البيولوجي ١٦,٧٤ ، ٣٦,٠٩ و ٤٦,٣٧ % عند معاملات الملوحة المستخدمة على التوالي. على الرغم من أن التأثير على وزن ١٠٠حبة كان غير معنوى بين معاملة المقارنة والرى بمياه ملحية ٤,٦٩ ديسى سيمنز/ م (٤,٤٥جم) أنخفض الى ٣,٨٣جم عند زيادة الملوحة الى ١٤,٠٦ ديسى سيمنز/ م. مثل هذا الانخفاض يتباين معنويا مع معدلات التسميد البوتاسي. مع متوسطات الملوحة ونوعى الارض أعطت معدلات التسميد ٣,٠ و ٤,٠ جم /برميل الى استجابة من صنف جيزة ١٦٨ بالنسبة لمحصول الحبوب وكذا الوزن البيولوجى ومكوناته المحصول.على الرغم من أن الفروق بين معدل التسميد ٣,٠و ٤,٠ جم /برميل كانت غير معنوية على كل الصفات المدروسة .

وبالنسبة الى نوع الأرض تأثرت كل الصفات المدروسة معنويا فيما عدا وزن ١٠٠حبة وكان محصول الحبوب للصنف جيزة ١٦٨ أعلى فى الأرض الطينية الطميية عن الجيرية بمقدار ٣٣,٩٣ % و الوزن البيولوجى ٣٠,٦٨%.

وأظهرت النتائج أن كفاءة البوتاسيوم وصلت اعلى قيمة عند معدل ٣,٠ جم /برميل. مع متوسطات نوعى التربة فأن مضاعفة المعدل من ١,٠ الى ٢,٠ جم /برميل ادى الى زيادة الكفاءه من ٤,٢٥ الى ٦,٤٠ بينما انخفض الى٤,٤٦ مع زيادة معدلات التسميد حتى ٤,٠ جم /برميل وذلك مع الرى بمياه الصنبور. وكانت قيم كفاءة البوتاسيوم مقبولة مع الملوحة المنخفضة عن العالية حيث كانت٥,٢٠، ٤,٨٦ و ٣,٩٩ مع ٤,٦٩، ٩,٣٨ و١٤,٠٦ ديسى سيمنز/ م على التوالي عند معدل ٣,٠ جم /برميل. ولذا يجب ان يعدل التسميد حسب الملوحة على الا تزيد ملوحى مياه الرى (ECw) عن ٤,٦٩ديسى سيمنز/ م لتجنب التأثير الضار للملوحة والحصول على إنتاجية عالية.