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Productivity of Some Bread Wheat Cultivars As Affected By Modern Irrigation System and Water Salinity in Sandy Soil

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Abstract

Two field experiments were carried out during winter seasons 2020/2021 and 2021/2022 at the Research and Production Station, National Research Centre, El-Nubaria, El-Behira Governorate, Egypt. to evaluate yield and yield component for two bread wheat cultivars (Giza 171 and Misr 1) under sprinkler and dripp irrigation systems with using four concentrations of water salinity irrigation. A split-plot design with three replications was used. Wheat cultivars were randomly distributed in the main plots while, while water salinity treatments occupied the sub-plots in both seasons. Results showed that Misr 1 cultivar recorded the highest values and highly significance for plant height, No. spikelets spike^{-1}, weight of spike(g) and grain yield fed^{-1}. While, Giza 171 cultivar gave the highest values and highly significance for tillers number and spikes/ m-2under sprinkler and drip irrigation system in over the combined analysis. cultivar and its components of wheat i.e. plant height (cm) , tillers number and spikes/ m^2, No. spikelets /spike, weight of spike (g) and grain yield/fed were highly significant affected by water salinity concentrations under sprinkler and drip irrigation system in the combined analysis. Significant impact of interaction between wheat cultivars and water salinity was gained for plant height, tillers number/ m^2, No. spikes/ m^2 and weight of spike under sprinkler irrigation system in combined data. Significant effect of interaction between wheat varieties and water salinity was obtained for Tillers number m^{-2} and No. spikelets spike^{-1} under drip irrigation system in combined data. It could be complemented that under the conditions of the experiment, planting Misr 1 cultivar with irrigated water salinity level (650 ppm) treatment under sprinkler and drip irrigation system is recommended.

Keywords: Bread wheat cultivars, Water salinity concentrations, Sprinkler and dripping irrigation, Yield and its components.

Introduction

Wheat is deemed the major exporter of food in the world and Egypt. Increasing wheat output out of growing productivity and the cultivated space is a substantial national base to diminish the gap between the Egyptian output and consumption. Raising wheat yield/unit area can be realized by breeding high yielding cultivars and beneficent the cultural dealings of the crop. Several investigators stated that, drip irrigation is more efficiency in water conserving, since there are reduced water losses through surface evaporation, less surface runoff, as well as minimal deep percolation. Sprinkle irrigation is the application of water in the form of a spray from the flow of water under pressure through small nozzles. The most common intent of sprinkle irrigation is to apply water uniformly to the soil surface to replace water extracted by plants. Many different approaches and practices may need to be combined to develop satisfactory systems for saline water irrigation. In general, crops tolerate salinity up to a threshold level, above which yields of the crops decrease, approximately linearly, as the salt concentration increases. Therefore, crop response to salinity levels is an important factor for irrigation by saline water.

Various researchers have found that wheat cultivars vary in productivity and characteristics

(**Hassan 2008; Mehasen *et al,* 2009; Mohammadi *et al,* 2011; Harb *et al,* 2012; Mehasen *et al,* 2013; Mehasen *et al,* 2014 ; Mehasen *et al,* 2015 and Abdel-Lattif, et al, 2019**).

Use of saline water for irrigation has the advantages of reducing fresh water requirement for salt-tolerant crops. But, salinity affects crops depending on its degree at critical growth stages and reduces the yield. So, irrigation by saline water needs to be controlled in an appropriate level for the specific crops. There is, however, no any single way to achieve the safe use of saline water in irrigation. Many different approaches and practices may need to be combined to develop satisfactory systems for saline water irrigation. In general, crops tolerate salinity up to a threshold level, above which yields of the crops decrease, approximately linearly, as the salt concentration increases. Therefore, crop response to salinity levels is an important factor for irrigation by saline water. An attention-grabbing observation was that irrigation by saline water of 4 dS m^{-1} contributed positively to the crop attributes. Spikelets per spike and yield of wheat increased compared to the control (**Mojid *et al,* 2013**).

Therefore, the present investigation was designed to study the performance and productivity of two bread wheat cultivars under two irrigation system sprinkler and dripping irrigation with using four concentrations water salinity irrigation, in El-Nubaria Region, El-Behira Governorate, Egypt.

Materials and Methods

The present study was carried out during winter seasons 2020/2021 and 2021/2022 at the Governorate, Egypt, to study the effect of four concentrations of water salinity irrigation (650, 1650, 2650 and 3650 ppm) on yield and yield components of two bread wheat cultivars (Giza 171 and Misr 1) under sprinkler and dripp irrigation systems.

The experimental soil was sandy in texture, pH value, organic matter (%) , CaCO3 (%) and EC (dSm^{-1}) were 7.82, 0.62%, 1.70% and 1.61 average of the first and second seasons, respectively.

The treatments were designed in a split-plot design with three replications. Wheat cultivars were sorted at random in the main plots while, water salinity treatments occupied the sub-plots in the two seasons. The sub-plot area was 10.5 m^2.

Cultivars of wheat were plowed on November 11^{th} and 7^{th} in the first and second seasons, respectively. P fertilizer with the average of 31 kg P_2O_5 fed^{-1} was one similar dose as calcium super phosphate form (15.5% P_2O_5) applied before drilling pending seedbed preparation. The common cultural pursuits were carried out like recommends in the region.

- Collected data.

Random patterns of ten plants were taken from every sub-plot at maturing time to set the following traits: plant height (cm), weight of spike (g) and number of spikelets $spike^{-1}$. For set tillers number and spikes/ m^{-2} a sample of one square meter from each sub-plot was taken. Grain (kg fed^{-1}) were predestined on total sub-plot basis.

- Statistical analysis.

Analysis of difference was done for the data of every season individually and combined analysis was proceeded for the data over the first and second seasons as stated by Snedecor and Cochran (1980) treatment means were compared using least significant difference test at 0.05 level of significance. Using the MSTAT-C Statistical Software package (Michigan State University, 1983).

Results and Discussion

Analysis of differences for whole treatments in each season moreover the combined analysis is exhibited in Tables (1&and 2). Test of homogeneity detected that the error difference for the first and second seasons were homogenous, therefore combined analysis was treated. Year's mean squares were extremely significant for all the studied characteristics under sprinkler and drip irrigation systems except spike weight and grain yield fed^{-1} were significant and plant height was insignificant under drip irrigation system. Wheat cultivars mean squares were extremely significant for all treatments in first and second seasons as well as the combined data under sprinkler and drip irrigation systems. Water salinity treatments mean squares were extremely significant for all characteristics in first and second seasons plus the combined data under sprinkler and drip irrigation systems. The interaction between years and wheat cultivars mean squares was not significant for all studied characters except grain yield fed^{-1} under sprinkler and drip irrigation systems, No. spikes/ m^2 under sprinkler irrigation system and No. spikelets $spike^{-1}$ under drip irrigation system. The interaction between years and water salinity treatments mean squares was insignificant for all of the studied characters except plant height, tillers number/ m^2 and grain yield/ fed^1 under sprinkler irrigation system and tillers number/ m^2, No. spikelets $spike^{-1}$ and spike weight under drip irrigation system. The interaction between wheat cultivars and water salinity treatments mean squares was not significant for all studied characters except Tillers number m^{-2} was highly significant and/or significant in both seasons as well as combined data, No. spikes m^{-2}, in the first season and combined data, spike weight in combined data under sprinkler irrigation system whereas, Tillers number m^{-2} were significant in the first season combined data, No. spikelets $spike^{-1}$ was highly significant in the second season and combined data, plant height and spike weight were highly significant in the second season only. The interaction between years, wheat cultivars and water salinity treatments mean squares were not significant for all of the studied traits under sprinkler and drip irrigation systems.

Table 1. Mean square values and significance for yield and its components of wheat cultivars under sprinkler irrigation in 2020/2021, 2021/2022 seasons and their combined analysis

SOV	df	plant Height (cm)	Tillers number m^{-2}	No. spikes m^{-2}	No. spikelet $spike^{-1}$	Spike weight (g)	Grain yield (kg fed^{-1})
Season 2020/2021							
Rep	**2**	3.974	164.04*	40.625	9.583**	0.113	5882.292
Varieties (V).	**1**	303.8**	620.1**	925.0**	56.734**	1.000**	112066.6**
Err.(a)	**2**	0.330	3.292	2.542	0.001	0.008	732.292
Salinity (S).	**3**	35.32**	470.8**	552.4**	10.135**	0.470**	547452.7**
VxS	**3**	0.558	18.83**	45.486*	0.085	0.007	1836.111
Err.(b)	**12**	0.469	1.333	11.694	0.032	0.002	1580.903
Season 2021/2022							
Rep	**2**	2.989	112.8**	112.54*	9.143**	0.044	10879.16**
Var.	**1**	221.9**	620.1**	468.1**	59.535**	1.270*	60501.04**
Err.(a)	**2**	0.611	0.542	1.292	0.046	0.021	29.167
Sali.	**3**	54.07**	386.9**	379.8**	12.200**	0.601**	410926.0**
VxS	**3**	2.110**	5.389*	0.944	0.166	0.012	89.931
Err.(b)	**12**	0.152	1.208	3.472	0.052	0.007	98.611
Combined analysis							
Years	**1**	29.78**	208.3**	305.0**	8.755**	0.658**	45942.18**
R(Y)	**4**	3.482*	138.4**	76.58**	9.363**	0.078	8380.729**
Var.	**1**	522.5**	1240**	1354**	116.25**	2.262**	168625.5**
V(Y)	**1**	3.209	-0.000	38.521*	0.017	0.008	3942.188*
Err.(a)	**4**	0.470	1.917	1.917	0.024	0.015	380.729
Sali.	**3**	88.23**	851.3**	920.1**	22.257**	1.066**	952364.4**
S(Y)	**3**	1.177*	6.389**	12.132	0.077	0.006	6014.410**
VxS	**3**	2.303**	18.05**	26.910*	0.093	0.014*	856.076
VxSxY	**3**	0.365	6.167**	19.521	0.158*	0.004	1069.965
Err.(b)	**24**	0.311	1.271	7.583	0.042	0.004	839.757

* and ** significant at 5% and 1% level of probability, respectively

Table 2. Mean square values and significance for yield and its components of wheat cultivars under drip irrigation in 2020/2021, 2021/2022 seasons and their combined analysis

SOV	df	Plant height (cm)	Tillers number m^{-2}	No. spikes m^{-2}	No. spikelet $spike^{-1}$	Spike weight (g)	Grain yield (kg fed^{-1})
Season 2020/2021							
Rep	**2**	6.482	136.29	158.16	10.385**	0.198**	8534.375
Var.	**1**	434.35*	640.66*	1335.0	47.602**	1.063**	1066.667
Err.(a)	**2**	5.362	14.542	81.167	0.032	0.001	1732.292
Sali.	**3**	32.24**	284.5**	436.3**	10.490**	0.350**	430381**
VxS	**3**	1.812	7.889*	5.042	0.038	0.006	3577.778
Err.(b)	**12**	3.231	1.639	12.333	0.022	0.013	1302.778
Season 2021/2022							
Rep	**2**	3.667*	360.7**	345.04	10.135**	0.031	5266.667
Var.	**1**	403.0**	468.1**	580.16	73.850**	1.664*	96266.667*
Err.(a)	**2**	0.129	2.042	37.042	0.020	0.035	1216.667
Sali.	**3**	44.35**	406.9**	346.5**	16.556**	0.605**	352672.2**
VxS	**3**	3.107**	2.278	2.278	2.262**	0.017**	2100.000
Err.(b)	**12**	0.363	1.528	8.875	0.033	0.002	986.111
Combined analysis							
Years	**1**	4.909	752.0**	1668**	5.810**	0.149*	24752.083*
R(Y)	**4**	5.074	248.5**	251.60	10.260**	0.114	6900.521
Var.	**1**	837.0**	1102**	1837**	120.01**	2.693**	58800.00**
V(Y)	**1**	0.293	6.750	77.521	1.435**	0.034	38533.33**
Err.(a)	**4**	2.745	8.292	59.104	0.026	0.018	1474.479
Sali.	**3**	75.85**	684.6**	772.4**	26.470**	0.917**	781046.5**
S(Y)	**3**	0.738	6.806*	10.465	0.576**	0.038**	2007.639
VxS	**3**	4.168	6.028*	4.410	0.976**	0.015	338.889
VxSxY	**3**	0.751	4.139	2.910	1.324**	0.007	5338.889*
Err.(b)	**24**	1.797	1.583	10.604	0.027	0.008	1144.444

* and ** significant at 5% and 1% level of probability, respectively

-Effect of cultivars.

The outcomes indicated in Tables (3&4) show clearly that, there were highly significant variance between cultivars in all studied traits under sprinkler and drip irrigation system in the combined analysis. Misr1 variety gave the greatest values of plant height (106.65 and 103.85 cm), No. spikelets spike^{-1} (20.46 and 21.52 spikelet), spike weight (2.38 and 2.48 g) and grain yield fed^{-1} (1969.37 and 2006.45 kg) compared with Giza 171 variety under sprinkler and drip irrigation system, respectively. While, Giza 171 variety gave the highest values of tillers number/ m^2 (341.25 and 337.91 tiller) and No. spikes/ m-2(333.20 and 330.62 spike) compared with Misr 1 variety under sprinkler and drip irrigation system, respectively.

It could be complemented that varietal variation among wheat cultivars may be because genetical make up. The superiority of Misr 1 variety in grain yield (kg fed^{-1}) over Giza 171 variety might be due to the increase in the growth and yield components. The results were obtained by **Mehasen *et al*, (2009); Mohammadi *et al*, (2011); Harb *et al*, (2012); Mehasen *et al*, (2013); Mehasen *et al*, (2014); Mehasen *et al*, (2015) and Abdel-Lattif, *et al*, (2019**) indicated marked differences among wheat cultivars in yield and yield components.

- Water salinity effect.

Results in Tables (3&and 4) showed that, yield and its components of wheat i.e. plant height, tillers number and spikes m^{-2}, No. spikelets spike^{-1}, spike weight and grain yield were highly significant affected by water salinity concentrations under sprinkler and drip irrigation system in the combined analysis. It is obvious that the significant greatest values of plant height (106.41 and 102.65 cm), tillers number/ m^2 (346.50 and 341.33 tiller), No. spikes/ m^2 (338.41 and 333.41 spike), No. spikelets spike^{-1} (20.40 and 21.49 spikelet), spike weight (2.47 and 2.55 g) and grain yield fed^{-1} (2190.00 and 2235.00 kg) under sprinkler and drip irrigation system, respectively were outputted by control trait (650 ppm) compared with other water salinity treatments. Otherwise, the high water salinity treatment (3650 ppm) outputting the minimum values of plant height (100.31 and 96.70 cm), tillers number m^{-2} (327.08 and 323.91 tiller), No. spikes/m^2 (317.83 and 314.83 spike), No. spikelets spike^{-1} (17.21 and 18.03 spikelet), spike weight (1.81 and 1.92 g) and grain yield fed^{-1} (1541.66 and 1664.16 kg) under sprinkler and drip irrigation system, respectively. It is therefore contemplated that if saline water is used only for supplemental irrigations, wheat might provide acceptable yield under higher salinity level. **Mojid *et al* (2013)** reported that plant height of wheat decreased from 75.4 cm under EC of 0.385 dS m^{-1} (control) to 67.6 cm under irrigation by saline water of EC 13 dS m^{-1}. It decreased by 0.7, 2.2, 9.3 and 10.3% in EC 4, 7, 10 and 13 dS m^{-1}, respectively compared to control treatment. No. spikes m^{-2} decreased with irrigation water salinity increased. The highest spike density was obtained under fresh water irrigation (control treatment), 10 and 13 dS m^{-1} treatments produced significantly lower spike density compared to control treatment.

Table 3. Grain yield and its components of wheat as affected by cultivars and water salinity concentrations under sprinkler irrigation system (over the combined analysis)

Treatments	Plant height (cm)	Tillers number m^{-2}	No. of spikes m^{-2}	No. spikelets spike^{-1}	Spike weight (g)	Grain yield (kg fed^{-1})
Wheat Cultivars						
Giza 171	100.05	341.25	333.20	17.35	1.94	1850.83
Misr 1	106.65	331.08	322.58	20.46	2.38	1969.37
Significance	**	**	**	**	**	**
Salinity concentration.						
650 (Control)	106.41	346.50	338.41	20.40	2.47	2190.00
1650	104.65	338.91	330.66	19.48	2.33	2054.58
2650	102.02	332.16	324.66	18.52	2.02	1854.16
3650	100.31	327.08	317.83	17.21	1.81	1541.66
LSD at 5%	**0.46**	**0.94**	**2.31**	**0.17**	**0.05**	**24.41**

Table 4. Grain yield and its components of wheat as affected by cultivars and water salinity concentrations under drip irrigation system (over the combined analysis)

Treatments	Height of plant (cm)	Tillers number m^{-2}	No. spikes m^{-2}	No. spikelet $spike^{-1}$	Spike weight (g)	Grain yield (kg fed^{-1})
cultivars						
Giza 171	95.49	337.91	330.62	18.36	2.01	1936.45
Misr 1	103.85	328.33	318.25	21.52	2.48	2006.45
F test	**	**	**	**	**	**
Salinity concentration						
650 (Control)	102.65	341.33	333.41	21.49	2.55	2235.00
1650	100.45	336.66	327.91	20.63	2.37	2116.66
2650	98.88	330.58	321.58	19.63	2.13	1870.00
3650	96.70	323.91	314.83	18.03	1.92	1664.16
LSD at 5%	**1.12**	**1.05**	**2.74**	**0.13**	**0.07**	**28.49**

-Interaction effect.

Significant influence of interaction between wheat cultivars and water salinity was get for plant height, tillers number m^{-2}, No. spikes/ $m^{-2}$and spike weight under sprinkler irrigation system in combined data (Table 5). Misr 1 variety irrigated with control water salinity (650 ppm) treatment afford the highest values of height of plant (109.78 cm) and spike weight (2.72 g) while, Giza 171 cultivar irrigated with control water salinity (650 ppm) treatment gave the highest values of tillers number m^{-2} (350.16 tiller) and No. spikes/ m-2(341.66 spike). On the other hand, Giza 171 variety irrigated with high water salinity (3650 ppm) treatment gave the lowest values of plant height (97.53 cm) and spike weight (1.65 g), whereas, Misr 1 variety irrigated with high water salinity (3650 ppm) treatment gave the lowest values of tillers number m^{-2} (321.50 tiller) and No. spikes/ m-2(311.00 spike) under sprinkler irrigation system in combined data.

Table 5. Effect of the interaction between cultivars and water salinity on yield and components of wheat under sprinkler irrigation (over the combined analysis)

Wheat Cultivars	Salinity concentration	plant height (cm)	Tillers number m^{-2}	No. spikes m^{-2}	Spike weight (g)
	650	103.05	350.16	341.66	2.23
	1650	101.45	343.50	336.33	2.10
Giza 171	**2650**	98.18	338.66	330.16	1.80
	3650	97.53	332.66	324.66	1.65
	650	109.78	342.83	335.16	2.72
	1650	107.86	334.33	325.00	2.56
Misr 1	**2650**	105.86	325.66	319.16	2.25
	3650	103.10	321.50	311.00	1.98
LSD at 5%		**0.66**	**1.34**	**3.28**	**0.07**

Significant impact of interaction between wheat cultivars and water salinity was secured for tillers number m^{-2} and No. spikelets $spike^{-1}$ under drip irrigation system in combined data (Table 6). Giza 171 variety irrigated with control water salinity (650 ppm) treatment gave the highest value of tillers number m^{-2} (347.16 tiller), while, Misr1 variety irrigated with control water salinity (650 ppm) treatment gave the highest value of No. spikelets $spike^{-1}$ (23.00 spikelet). On the other hand, Misr 1 variety irrigated with high water salinity (3650 ppm) treatment gave the lowest value of Tillers number m^{-2} (319.33 tiller), whereas, Giza 171 variety irrigated with high water salinity (3650 ppm) treatment gave the lowest value of No. spikelets $spike^{-1}$ (16.03 spikelet) under drip irrigation system in combined data.

Table 6. Effect of the interaction between wheat cultivars and water salinity on yield attributes under drip irrigation (over the combined analysis)

Wheat Cultivars	Salinity concentrations.	Tillers number m^{-2}	No. spikelets $spike^{-1}$
	650	347.16	19.98
	1650	341.16	19.18
Giza 171	**2650**	334.83	18.26
	3650	328.50	16.03
	650	335.50	23.00
	1650	332.16	22.08
Misr 1	**2650**	326.33	21.00
	3650	319.33	20.03
LSD at 5%		**1.49**	**0.19**

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إنتاجية بعض أصناف قمح الخبز المتأثرة بنظم الرى الحديثه وملوحة مياه الرى في الاراضى الرمليه

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نفذت تجربتان حقليتان خلال الموسمين الشتويين 2021/2020 و2022/2021م في مزرعة محطة البحوث والإنتاج التابعة للمركز القومي للبحوث، بمنطقة النوبارية، محافظة البحيرة، مصر. كان الهدف من هذه الدراسة هو تقييم المحصول وبعض مكوناته لصنفي قمح الخبز (جيزة 171 ومصر 1) تحت نظامي الرى بالرش والرى بالتنقيط بإستخدام أربع تركيزات مختلفه من الملوحه في مياه الري (650 ، 1650 ، 2650 ، 3650 جزء في المليون).

أظهرت النتائج تفوق عالي المعنوية للصنف مصر 1 لصفات إرتفاع النبات (سم) ، عدد أبراج السنبلة ، وزن السنبلة (جم) ومحصول الحبوب للفدان (كجم). بينما أظهر الصنف جيزة 171 تفوق عالي المعنوية لصفتي عدد الأشطاء والسنابل في المتر المربع تحت نظامي الري الرش والري بالتنقيط للتحليل التجميعي لموسمي الزراعة.

أعطت معاملة الكنترول لتركيز الأملاح في مياه الري (650 جزء في المليون) زيادة معنوية لكل الصفات تحت الدراسة. بينما سجلت أعلي معاملة لتركيز الأملاح في مياه الري (3650 جزء في المليون) نقص معنوي لكل الصفات المدروسة تحت نظامي الري الرش والري بالتنقيط للتحليل التجميعي لموسمي الزراعة.

أظهر التفاعل بين أصناف قمح الخبز وتركيز الأملاح في مياه الري فروق معنوية لصفات إرتفاع النبات ، عدد الأشطاء والسنابل في المتر المربع ووزن السنبلة تحت نظام الري بالرش لتحليل الضم لموسمي الزراعة. وأيضا أظهر التفاعل بين أصناف قمح الخبز وتركيز الأملاح في مياه الري فروق معنوية لصفتي عدد الأشطاء والسنابل في المتر المربع وعدد أبراج السنبلة تحت نظام الري بالتنقيط للتحليل التجميعي لموسمي الزراعة.

توصي هذه الدراسه بزراعة صنف مصر 1 تحت ظروف ملوحه في مياه الري (650 جزء في المليون) والري بالرش أو بالتنقيط في منطقة النوبارية محافظة البحيرة – مصر والمناطق المماثلة لها.