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Effect of Different Nitrogen Fertilizer Levels, and Wheat Cultivars on Yield and its Components under Sprinkler Irrigation System Management in Sandy Soil

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Abstract: The current research work was conducted at the Research and Production Station of National Research Center, El-Noubaria, El-Buhaira Governorate, during the two successive seasons under sprinkler irrigation system to study the response of four wheat varieties: Misr 1, Misr 2, and Sids 12 cultivars, two riser height sprinklers 1.00 and 0.75 m and different nitrogen fertilizer levels (75, 100, 125 kg/fed) on yield, yield components and water productivity with sandy soil conditions. It aimed to evaluate the effect of different nitrogen fertilizer levels and different varieties on yield, yield components of wheat as a flour source for human nutrition. The experiment design was factorial in complete randomized blocks with three replications. The results could be summarized as follows: according to the main effects under study, means values of data obtained could be ranked in the following ascending orders 75 < 100 < 125, 0.75 < 1.0 and Sids 12 < Misr 2 < Misr 1. Regarding sprinkler riser height, the increase percent by using 1.00 m were (2.7; 3.3) relative to 0.75 m in 1st and 2nd season. For Nitrogen levels, the increase percent under 125 kg/fed level were (2.3; 5.3) relative to 75 kg/fed level in 1st and 2nd season. According Egyptian wheat varieties, the increase percent with Misr 1 were (14.5; 16.3) relative to Sids 12 variety in 1st and 2nd season, respectively. All obtained data had significant differences at 5 % level exception little cases. It could be concluded that: although 125 kg N/fed treatment gave the highest values, using 100 or 75 kg N/fed with a variety of Misr 1 and Misr 2 for best water productivity, grain yield production and its component's purpose, while for better flour we can recommend that using nitrogen level 120 kg N/fed, sprinkler riser height 1.00 m and variety of Misr 1.
Key words: Sprinkler irrigation, Nitrogen, Egypt, Wheat verities, Yield, Water, Sandy soil.

Introduction

Wheat is the most important cereal crop in the world in terms of area and production and it is a stable food for more than one third of the world population in Egypt, wheat is the main winter cereal crop, it is used as a stable food grain for urban and rural societies and as a major source of straw for animal feeding. The wheat area over the last 10 years (2003-2013) has been expanded from (0.43 to 0.59 million Feddan) and the average productivity per Feddan has been increased from 6.4 to 8.8 million ton during that period, however total wheat consumption has increased drastically due to overall population growth of about 2.5 % per year Therefore,

Egypt imports about 75 percent of wheat requirements this reflects the size of the problem and the efforts needed to increase wheat production gab, due to extremely limited lands. This can be achieved by planting high potential yield cultivars as well as conducted the best agricultural practices such as soil and foliar fertilization, with macro and micro nutrients. **Abd El-Moneim[1]** revealed that nitrogen fertilization treatments had a significant difference on plant height, spike number of spikelets /spike, number of spike/m^2, grain and straw yield /ha. by increasing nitrogen treatments from 30 to 75 kg N./fed. **Mahmoud[2]** revealed that raising nitrogen levels from 75 to 75 and 100kg N/fed. significantly increased plant height, flag leaf area, number of spike/m, spike length, number of spikeles/spike, number of grains/spike, 1000-grain weight, grain and straw yields /fed, and harvest index.

Sabrey etl[3] found that increasing N levels from 0 to 125 kg N/fed. Significantly increased grain yield, number of spikes/m^2 and number of kernels/ spike. **Ibrahim etl[4]** revealed that increasing nitrogen levels from 0 to 25, 50 and 75 kg N/fed. Significantly increased plant height, number of days to 50% heading, relative water content (RWC) number of spikelets /spike, number of spikes/m^2, 1000-grain weight and straw yields/fed. **Gomaa[5]** revealed that increasing the nitrogen level from zero to 30, 75,100 and 125kg N/fed. Significantly increased plant height, number of spikes/m^2, spike length, 1000-grain weight and grain and straw yield /fed specially the highest level 125 kg N/fed. **Allam[6]** indicated that increasing nitrogen levels up to 100 kg N/fed. Significantly increased spike length, number of spikes/m^2, number of grain/spike, grain yield as well as 1000-grain weight and straw yield. The levels of 125 kg N/fed was noticed with plant height, spike length and straw yield. **Abo-Warda[7]** tried two N levels i.e. 168 and 240 kg N/ha (70.6 – 100.8kg N/fed) to wheat grown under sandy soil conditions. He found that the increase of N level was accompanied by a significant increase in grain yield and almost all of its attributes.

Ashmawy and Abo-Warda[8] studied the effect of five N levels (30, 75, 100, 125 and 150 kg N/fed) on wheat grown under sandy soil conditions. They found that the number of spikes/m^2 and number of grains/spike responded to the increase of N level up to 150 kg N/fed, but the grain yield/fed and 1000-grain weight responded to the increase of N level up to only 125 kg N/fed. **El-Naggar[9]** showed significant differences among wheat growth traits, grain yield and its components where the linear and quadratic components of the response curve of N fertilization were significant. The peak for the maximum grain yield (20.85 ard/fed) could be obtained with the addition of 312 kg N/fed. **Sarhan[10]** tried two N levels (56 and 75 kg N/fed) to wheat grown under old land conditions. He found that the grain and straw yields/fed responded with 56 and 75 kg N/fed, respectively.

Ahlam[11] found that increasing fertilizer rates significantly increased grain yield. The highest mean values of 2.26 and 2.6 ton/fed were obtained with 100 kg N/fed in first and second season, respectively, and she found that the mean values of nitrogen and protein percentages were increased by increasing both mineral and biofertilizers applications.

Kelley[12] and Ruske atl[13] founds that fungicide application increased test weights at most site and variety combinations tested. Although increases were not always significant, the effect of variety was strongly associated with the variability of test weight increases due to fungicide in both studies. **Hamam etl[14] and Sial etl[15]** states that stability in yield of varieties over a wide range of environments is of great concern to plant breeders. **Nemat A. Noureldin etl[16]** investigated the productivity of four bread wheat cultivars, namely Giza-168, Sakha-94, Gemmeiza-10, and Sids-12 under different nitrogen levels, i.e. 0, 25, 50, 75, 100, and 125 kg N/fed. The obtained results showed significant differences among the tested wheat cultivars in the two seasons in a number of spikes/m^2, spike length, kernels number/spike, kernels weight/spike, weight of 1000 kernels, and grain and straw yields/fed. Gemmeiza-10 along with Sids-12 produced the highest weight of 1000 kernels surpassing the other cultivars in the second season only. Gemmeiaza-10 was the superior cultivar for producing a higher grain yield, but statistically leveled with Sakha-94 in the 1st season and with Sids-12 in the 2nd one. Moreover, straw yield of Giza-168 was higher than each of other cultivars in the 1st season, while Gemmeiza-10 along with Sids-12 gave the maximum straw yield in the 2nd season. Increasing N up to 75 kg/fed increased yield and its attributes of wheat in both growing seasons.

The present investigation aimed to study the response of four wheat varieties (Misr 1 ; 94, Gemmiza 9, and Sids 13) to the application of different nitrogen levels (75, 100, 125 kg N/fed) in the new cultivated land at El-Nobaria, El-Behaira Governorate (National Research Center, Research Station Farm) on yield components and some technological criteria.

Materials and Methods

The present investigation was conducted at the National Research Center, El-Noubaria Research Station El-Behaira Governorate, during the two successive seasons of to study the effect of three Egyptian wheat varieties: 1- Misr 1, 2- Misr 2, and Sids 12 cultivars to different three nitrogen fertilizer levels 125, 100; 75 kg/fed and two sprinkler riser heights 0.75; 1.00 m on yield components, biological yield and water productivity. Some soil physical, chemical and water properties of the studied soil are carried out after **Klute**[17] and moisture retention at field capacity and wilting point after **Rebecca**[18]. Soils of both investigated sites were sandy loam in texture. Some soil chemical characteristics of the studied two sites were recorded in **Table 1**. Analysis farmyard manure used in the experiments was as follows: 4.85 dSm^{-1} (EC, 1:20), 7.77 (pH, 1:20), 11.2% (OM), 5.4, 0.85 and 1.12% total (N, P and K) and 1:16.5 (C:N ratio).

Table (1) Soil properties of National Research center Research Station.

Site	pH	EC dSm^{-1}	OM	$CaCO_3$	(Soil water content %vb)		
			%		FC	WP	AW
NRC Farm	8.2	2.6	1.3	3.8	12.6	4.7	7.9

pH: (1.25), EC: electrical conductivity in the extracted soil paste, OM: organic matter, FC: field capacity, WP: wilting point, AW: available water, vb: volume basis. Sprinkler irrigation sysem components as showing in Fig. (1)

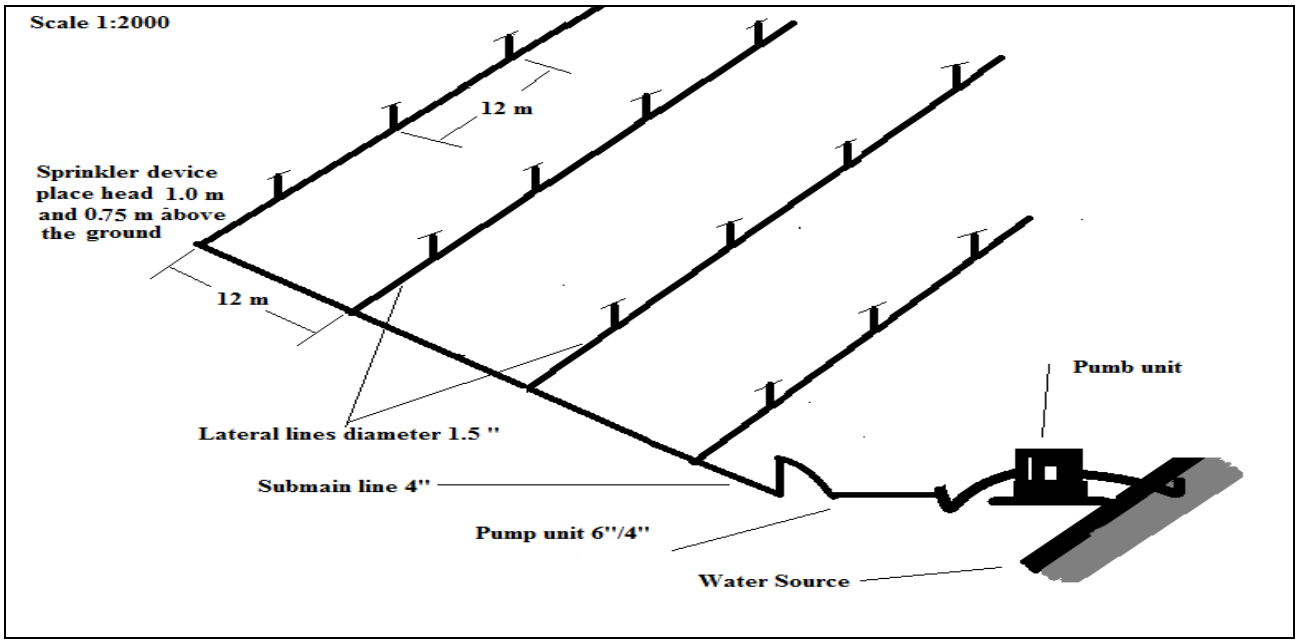


Figure (1) Layout of sprinkler irrigation system.

The experimental design was a factorial including two factors in a completely randomized block design with 3 replicates as showing in Fig. (2). The block area was 16 m^2 (4 x 4). NPK fertilization added according to recommended by the Egyptian Agricultural Ministry, while the nitrogen fertilizer was added in association of testing levels as follows:

1. Low (75 kg N/fed.)
2. Medium (100 kg N/fed.)
3. High (125 kg N/fed.)

Nitrogen fertilizer was added as urea (46.5 % N) at two equal doses, the first was applied before the first irrigation and the second one was added. Three weeks later phosphorus as (100 kg) mono-calcium superphosphate (15.5% P_2O_5) and potassium as (100 kg) potassium sulfate (48% K_2O) were added after seed sowing and before irrigation. Ten spikes were taken at random from each block at harvest, then the averages of the number of grains/spike and grains weight/spike were determined. This character was measured after heading by using a woody frame of one square meter which put at random on the plants of each block and the internal fertile spikes was counted and recorded. This was measured by collecting samples at random from grain yield

of each block and then 1000-grain was counted and weighted. Plants in each block were harvested, and then weigh as a total yield. The harvested plants were threshed and the grains of each block were collected and weighed. The grain yield was expressed as Ardab/fed. (Ardab =150 kg). This was calculated by subtracting the grain yield from the total yield and converted to ton/fed. Data measurements: Grain samples harvested were taken from of each block, from each of which a subsample was analyzed for protein concentration using a Unity Scientific at (Agricultural Research Center), Unity Scientific, with protein recorded on a dry matter basis. Test weight was measured at harvest in using harvested grain yield. Test weights in this study have a caveat: readings were taken on a wide range of moisture contents; conversion to standard test weight depends on the physical characteristics of the grain staying the same at higher moistures. Using moisture content to standardize test weights should give a reasonable estimate, however **Hellevang[19].**

Water productivity was calculated according to water use efficiency method as following:

WP (Kg/m^3) = Yield (Kg/feddan) / Water amount (m^3/feddan)

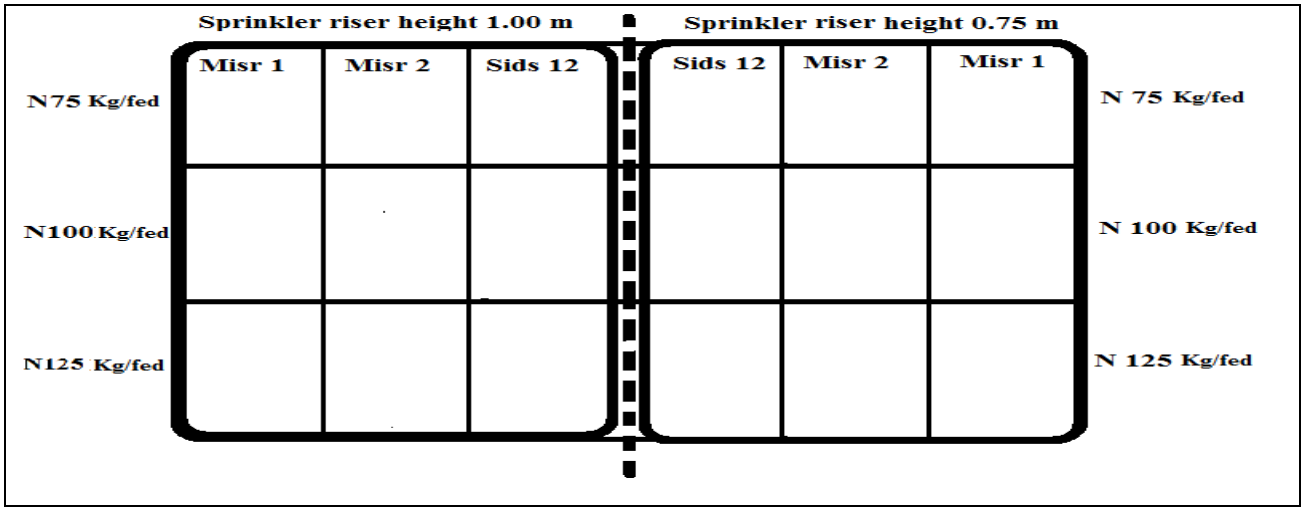


Figure (2) Layout of the field experiment with main factors distribution

The data were subjected to the proper statistical analysis of variance according to **Sndecor and Cochran[20]**. The differences among means were compared using least Significant Differences (L.S.D) at the 0.05 level of significance.

Results and Discussion

In Egypt, sprinkler irrigation system, nitrogen fertilization and wheat varieties have a great contribution in raising bread wheat grain yield/fed and quality in all important producing areas and special in new reclaimed lands or sandy soil.

Data in Table (2) illustrate the effect of three nitrogen levels (75, 100 and 125 kg N/fed) on a number of spikes/m^2 , 1000 kernel weight (g) and total biological yield(ton/fed) on the first and second seasons, respectively. Regarding main effects under study, means values of the number of spikes/m^2, It could be ranked in the following ascending orders: 75 < 100 < 125, 0.75 < 1.0 and Sids 12 < Misr 2 < Misr 1. According to a number of spikes/m^2, the effect of nitrogen levels on all studied characters there are significant differences at the 5 % level between all values of characters. Regarding to the number of spikes/m^2, gradually increases were detected by increasing nitrogen levels, where application of 125 Kg N/fed achieved the maximum number of spikes/m^2 (405, 406 spikes/m^2) in the first and second season, respectively. The results of cultivars (Misr 1) where it gave the highest number of spikes/m^2 (399; 401 spikes/m^2) in first and second seasons, respectively.

Data in Table (2) show the effect of three nitrogen levels (75, 100 and 125 kg N/Fed) on 1000 kernel weight (g) in the first and second seasons, respectively. Regarding to main effects under study, means values of 1000 kernel weight (g), it could arrange in the following ascending orders: 75 < 100 < 125, 0.75 < 1.0 and Sids 12 < Misr 2 < Misr 1. According to 1000 kernel weight (g), the effect of nitrogen levels and wheat cultivars on all studied characters, there are significant differences at the 5 % level between all values of characters.

Regarding to 1000 kernel weight (g), increases gradually were detected by increasing riser height and nitrogen levels, where application of 125 Kg N/fed achieved the maximum 1000 kernel weight (g) (43.92 and 45.63 g) in the first and second season, respectively.

Table (2) showing that the high 1000 kernel weight (g) variety Misr 1 significantly exceeded at 5 % level. Regarding to main effects under study, means values of 1000 kernel weight (g), it could arrange in the following ascending orders: 75 < 100 < 125, 0.75 < 1.0 and Sids 12 < Misr 2 < Misr 1. The results of interaction (125 X 1.0 X Misr 1) gave the highest 1000 kernel weight (g) (43.92 and 45.63 g) in first and second seasons, respectively. The lowest values of 1000 kernel weight (g) (41.28 and 42.63 g) achieved under interaction 75 X 0.75 X Sids 12.The interaction between nitrogen levels and wheat cultivars had significant effect on 1000 kernel weight (g). The data mentioned above, agreed with **Tawfik and Tammam[21], Allam[6] and Mohamed[22].**

Table (2). Effect of nitrogen fertilizer levels, sprinkler device height and wheat cultivars on number of spikes/m^2, 1000 kernel weight (g) and total yield through two growing seasons.

Nitrogen treatments (Kg/Fed.)	Sprinkler device height (m)	Egyptian wheat cultivars	Number of spikes/m^2		1000 kernel weight (g)		Total yield (Grain+Straw) (ton/fed)	
			Season		Season		Season	
			1st	2nd	1st	2nd	1st	2nd
125	1.00	Misr 1	399	403	41.28	42.63	6.87	7.75
		Misr 2	396	399	38.67	40.53	6.56	6.97
		Sids 12	383	385	35.57	36.21	6.43	6.68
	0.75	Misr 1	387	389	40.21	41.65	6.74	7.61
		Misr 2	381	383	37.75	39.58	6.35	6.73
		Sids 12	375	378	34.25	35.24	6.25	6.35
100	1.00	Misr 1	402	404	42.54	43.25	6.96	7.85
		Misr 2	400	401	41.43	42.65	6.42	6.82
		Sids 12	391	389	40.08	41.53	6.08	6.49
	0.75	Misr 1	399	402	41.34	42.35	6.77	7.74
		Misr 2	397	400	40.25	41.34	6.31	6.65
		Sids 12	395	397	39.65	40.07	5.89	6.12
75	1.00	Misr 1	405	406	43.92	45.63	7.19	7.97
		Misr 2	403	404	43.81	44.87	6.57	7.86
		Sids 12	398	399	42.14	43.27	5.77	6.85
	0.75	Misr 1	402	404	43.8	45.04	7.05	7.77
		Misr 2	401	402	42.76	44.52	6.53	7.56
		Sids 12	396	397	41.25	40.36	5.24	6.54
$LSD_{0.05}$ Interaction			0.20	0.40	0.14	0.11	0.01	0.02
Means	75		387	390	37.96	39.31	6.53	7.02
	100		397	399	40.88	41.87	6.41	6.95
	125		401	402	42.95	43.95	6.39	7.43
	1.00		397	399	41.05	42.29	6.54	7.25
	0.75		393	395	40.29	41.13	6.35	7.01
	Misr 1		399	401	42.18	43.43	6.93	7.78
	Misr 2		396	398	40.77	42.25	6.46	7.09
	Sids 12		390	391	38.8	39.45	5.94	6.51
$LSD_{0.05}$ for Means			0.5	0.8	0.15	0.12	0.03	0.02

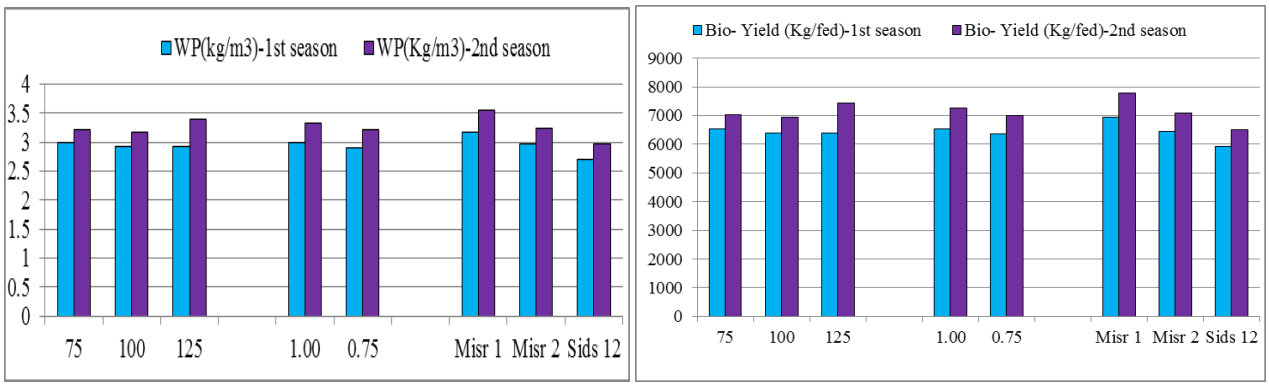
Data in Table (2) illustrate that the effect of three nitrogen levels (75, 100 and 125 kg N/fed), two sprinkler riser height and three wheat varieties on total biological yield (grain + straw) (ton/fed) in the first and

second seasons, respectively. Regarding to main effects under study, means values of total yield (ton/fed), It could arrange in the following ascending orders: 75 < 100 < 125, 0.75 < 1.0 and Sids 12 < Misr 2 < Misr 1. According to total yield (ton/fed), the effect of nitrogen levels on all studied characters there is significant differences at the 5 % level between all values of characters. Regarding to total yield (ton/fed), gradually increases were detected by increasing nitrogen levels, where application of 125 kg N/fed achieved the maximum Total yield (ton/fed) (6.39, 7.43 ton/fed) in the first and second season, respectively. Table (2) showing that the high total yield (grain + straw) (ton/fed) variety Misr 1 significantly exceeded at 5 % level. Regarding to main effect of sprinkler riser height, means values of total yield (ton/fed), It could arrange in the following ascending orders: 0.75 < 1.0. The results of sprinkler riser height (1.00 m) were the better in yield productive, it gave the highest total yield (ton/fed) (6.54, 7.25 ton/fed) in first and second seasons, respectively. The interaction between nitrogen levels, sprinkler height and wheat varieties had a significant effect on total yield (ton/fed) and the maximum total yield (ton/fed) recoded (7.19, 7.97 ton/fed) were obtained from (125 X 1.00 X Misr 1). The results mentioned above, agreed with **Mansour etl[23], Abdelmawgoud etl[24] and Soliman[25].**

Data in Table (3) and Fig (3) indicated that the effect of nitrogen levels (75, 100 and 125 kg N/fed), two sprinkler riser heights (0.75 and 1.00 m) and three wheat varieties (Misr 1, Misr 2, Sids 12 on water productivity (Kg/m^3) in the first and second seasons. Regarding to means values of water productivity (Kg/m^3), It could be ranked in the following ascending orders: 75 < 100 < 125. According to water productivity (Kg/m3), the effect of nitrogen levels on water productivity, there are significant differences at the 5 % level between all values of characters. Regarding to water productivity (Kg/m3), gradually increases were detected by increasing nitrogen levels, where application of 125 Kg N/fed achieved the maximum water productivity (Kg/m3) (2.99, 3.21 kg/m^3) in the first and second season, respectively.

Table (3) and Fig (3) illustrates that the main effect of two sprinkler riser heights (0.75, 1.00 m) in the first and second seasons. Regarding to means values of water productivity (Kg/m^3), It could arrange in the following ascending order: 0.75 < 1.0. According to water productivity (Kg/m^3), the effect of nitrogen levels on all studied characters there is significant differences at the 5 % level between all values of characters. Regarding to water productivity (Kg/m^3), gradually increases were detected by increasing sprinkler riser height, where riser height 1.00 m achieved the maximum water productivity (Kg/m^3) (2.99, 3.32 Kg/m^3) in the first and second season, respectively.

Regarding to main effects of wheat varieties under study, means values of water productivity (Kg/m^3), It could arrange in the following ascending order: Sids 12 < Misr 2 < Misr 1. The highest values were achieved under Misr 1 varity (3.17, 3.56 Kg/m^3) in the first and second season, respectively. The interaction between nitrogen levels, two sprinkler riser heights and wheat varieties had a significant effect on water productivity (Kg/m^3) and the maximum number of water productivity (Kg/m^3) (3.01, 3.60 Kg/m^3) were obtained from 125 X 1.00 X Misr 1X. The results mentioned above, agreed with **Saleh[26] and Abdelwahed[27]**.



A) Water productivity **B) Biological yield**

Fertilizer N levels: 75, 100 and 125 Sprinkler riser heights: 1.00 and 75m Wheat varities: Misr 1, Misr 2 and Sids 12

Fig. (3) the effect of main effects under study on bilogical yield and water productivity

Table (3). Effect of nitrogen fertilizer levels, sprinkler device height and wheat cultivars on Grain yield (Kg/Fed.) and Water productivity (Kg/m^3) through two growing seasons.

Nitrogen treatments (Kg/Fed.)	Sprinkler device height (m)	Egyptian wheat cultivars	Water amounts (m^3/Fed)		Yield production (Kg/Fed)		Water Productivity(Kg/m^3)	
			Season		Season		Season	
			1st	2nd	1st	2nd	1st	2nd
125	1.00	Misr 1	2185.7	2185.7	6870	7752	3.14	3.55
		Misr 2			6563	6971	3.00	3.19
		Sids 12			6428	6681	2.94	3.06
	0.75	Misr 1			6740	7613	3.08	3.48
		Misr 2			6351	6728	2.91	3.08
		Sids 12			6259	6350	2.86	2.91
100	1.00	Misr 1			6962	7852	3.19	3.59
		Misr 2			6423	6819	2.94	3.12
		Sids 12			6011	6493	2.75	2.97
	0.75	Misr 1			6769	7740	3.10	3.54
		Misr 2			6313	6652	2.89	3.04
		Sids 12			5898	6118	2.70	2.80
75	1.00	Misr 1			7198	7971	3.29	3.65
		Misr 2			6573	7863	3.01	3.60
		Sids 12			5769	6848	2.64	3.13
	0.75	Misr 1			7048	7778	3.22	3.56
		Misr 2			6532	7559	2.99	3.46
		Sids 12			5239	6538	2.40	2.99
$LSD_{0.05}$ Interaction					0.4	0.3	0.03	0.07
$LSD_{0.05}$ for Means					0.5	0.6	0.02	0.02

According to main effects under study, means values of yield (ton/fed), It could be ranked in the following ascending order: 75 < 100 < 125, 0.75 < 1.0 and Sids 12 < Misr 2 < Misr 1. All data obtained had significant differences at 5 % level exception little cases.

The interaction between nitrogen levels and wheat cultivars had a significant effect on straw yield (ton/fed) and the maximum number of yield (ton/fed) 7.28; 7.97 ton/fed) were obtained from Misr 1 wheat variety fertilized with 125 kg N/fed. The interaction between nitrogen levels and wheat cultivars had a significant effect on the number of spikes/m^2 and the maximum number of spikes/m^2 (405, 406 spikes/m^2) were obtained from 125X1.0XMisr 1. The increasing in the number of spikes/m^2 might be due to the high uniformity with 1.0 m height sprinkler riser and the role of nitrogen in stimulating the merited acting and cell elongation of the plant. These results could be attributed to increasing seed yield/fed and the important role of nitrogen on amino acid structure. Data mentioned above about straw yield agreed with **El-Nasharty[28], El-Guibali etl[29], Mansour[30] and Pibars and Mansour[31].**

Conclusion

The current research work purposed to evaluate the effect of different nitrogen fertilizer levels, sprinkler riser height and different varieties on yield, yield components, water productivity of Egyptian wheat varieties as a flour source for human nutrition. The experiment included three levels of nitrogen, i.e. 75, 100; 125 kg N/fed, two sprinkler riser heights, i.e. 0.75 ; 1.00 m and three Egyptian wheat varieties Misr 1, Misr 2; Sids 12. The design of experiments was factorial in complete randomized blocks with three replications. According to main effects under study, means values of straw yield (ton/fed), It could be ranked in the following ascending order: 75 < 100 < 125, 0.75 < 1.0 and Sids 12 < Misr 2 < Misr 1. All data obtained had significant differences among means at 5 % level and exception little interactions cases.

It could be concluded that: although 125 kg N/fed treatment gave the highest values, using 100 or 75 kg N/fed with a variety of Misr 1 and Misr 2 for best water productivity, grain yield production and its component's purpose, while for better flour we can recommend that using nitrogen level 120 kg N/fed, sprinkler riser 1.00 m and verity of Misr 1.

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