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RATIONALIZATION OF IRRIGATION WATER AND NITROGEN FERTILIZERS FOR WHEAT BY USING MICROBIAL INOCULANTS UNDER TWO SURFACE IRRIGATION METHODS

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ABSTRACT

Two field experiments were carried out at Sakha Agricultural Research Station, Kafr El-Sheikh Governorate, North Middle Nile Delta region during the two successive winter growing seasons of 2008/2009 and 2009/2010. The main objective of the study was to decrease the amount of nitrogenous fertilizers by using the fixed nitrogen bacteria and microbial inoculants and their effects on wheat productivity under two surface irrigation methods. Also, this work aims at comparing the two surface irrigation methods for wheat irrigation, identification the best irrigation method for both wheat and rationalization water consumption and studying some water relations. The experimental design was split plot with four replicates. The main treatments were irrigation methods, A_1 basin irrigation and A_2 corrugation while the submain treatments were fertilization and application of microbial inoculants; B_1 mineral nitrogen, B_2 raise the available nitrogen in the soil till the recommended dose, B_3 50 unit of nitrogen + Azospirillum inoculation and B_4 50 unit of nitrogen + Azospirillum inoculation + Humates incorporated by micronutrients.

The obtained results can be summarized as follows:

1. The values of applied irrigation water were increased under basin irrigation method (A_1) comparing with corrugation one (A_2). Data also showed that the values of applied irrigation water were not affected by fertilization treatments.
2. The highest values of water consumptive use were recorded under basin irrigation method (A_1) in the two growing seasons comparing with the corrugation one (A_2). Concerning with fertilization effect data indicated that the highest value was recorded under B_4 treatment. Also, data illustrated that the highest mean values were recorded under A_1B_4 and A_2B_4 in the two seasons.
3. The highest mean values of both water utilization efficiency (W.ut.E) and water use efficiency (W.U.E.) were recorded under corrugation irrigation method (A_2) comparing with basin irrigation one (A_1) and the highest values were recorded under $A_1B_4$and A_2B_4 in the two seasons.
4. The mean values for wheat grain yield were increased under basin irrigation (A_1) comparing with corrugation one (A_2). For the effect of fertilization on wheat grain yield the best treatment was B_4.
5. The mean values for straw yield, biological yield, harvest index and 1000-grain weight were increased under local surface irrigation method (A_1) comparing with corrugation one (A_2) in the two seasons. Data also showed that the above mentioned studied parameters were increased under B_4 fertilization treatment in the two seasons and the mean values can be descended in order $B_4 > B_3 > B_2 > B_1$.

INTRODUCTION

Wheat (*Triticum aestivum*) is an important strategically crop in Egypt because it considers indispensable part in Egyptian food diet. There is a great gap between the consumption and production of wheat. It is hoped to reduce such gap in the near future by increasing wheat production. Narrowing this gap is a national policy in Egypt.

After the construction of the High Dam, the agriculture intensified and continued cropping, soil fertility tended to decrease. So, the careness of raising soil fertility by fertilization becomes a must but using the mineral fertilizers particularly nitrogenous ones consider high in pricing and cause pollution for both soil and water with nitrates and other nutrients including heavy metals. This makes it is very harmful to use drainage water in irrigation except after treatment to get rid of these pollutants, this needs high expenses. To reduce this bad effect for nitrogen fertilizers, this can be happened by using microbial inoculants and humates that are very rich sources for nitrogen and other elements and also safe for using in the environment. Moreover, its expenses are low comparing with using mineral ones. Using these biofertilizers also play an important role to get rid of a large amount of wastes which can cause pollution for the environment. Also, using these kind of fertilizers increase yield comparing with mineral ones, and improve soil-physical and chemical properties (Chefetz *et al.*, 2000 and Melero *et al.*, 2007).

Besides the importance of fertilization as a limited factor for wheat production, irrigation stands on an equal footing or more because there is a limitation of water resources. The present capita share for water is less than poverty edge of 1000 m^3/year. In addition, the water demand is continuously increasing due to population growth, increased economic activities and the escalating standards of living. So, the rationalization of crop irrigation is very urgent to make water saving for using it for adding a new land areas or for other cultivated crops. The agricultural sector considers the highest consuming sector for water around the country where it consumes about 85% from Egypt water supply.

Application of irrigation water is a main tool in crop water management. In this study, two methods under the dominant surface irrigation were tested namely, local irrigation (basin) and corrugation with their effects on wheat production and some water relations.

MATERIALS AND METHODS

The present study was conducted at Sakha Agricultural Research Station, Kafr El-Sheikh Governorate during the two successive winter growing seasons 2008/2009 and 2009/2010 to study the interaction effect of irrigation method, application of mineral nitrogen as well as microbial inoculants (all strains were kindly obtained from the stock culture collection of dept. of soil Microbiology at Sakha Agric. Res. Station) on wheat production and some water relations. Moreover, decreasing the mineral nitrogen fertilizers by using

Azospirillum for wheat production under basin and corrugation surface irrigation methods. Some physical and chemical properties for the studied soil before cultivation are shown in Tables (1 and 2).

Wheat (Sakha 93 variety) was sown on 15 November in the two growing seasons with dry broadcasting method, crop was harvested on 1 May, 2009 and 6 May 2010. The plot area was 52.5 m^2 (7.5m length x 7m width) (1/80 fed) and the experimental design was split plot involving two factors; main treatments (irrigation methods) and sub-treatments were randomly assigned by fertilizers.

A.Main treatments (irrigation methods)

1.Basin irrigation

2.Corrugation

B.Sub treatments (fertilizers)

1.Mineral-N

2.Raise the available nitrogen in the soil up to the recommended dose.

3.50 unit of N + Azospirillum inoculation.

4.50 unit of N + Azospirillum inoculation + Humates incorporated by micronutrients.

Table (1):The mean values of some physical properties of the studied site before wheat cultivation in the two growing seasons.

Soil depth (cm.)	Particle size distribution				Texture class	FC %	P.W.P %	A.W %	Bd kg/m^3
	Coarse sand %	Fine sand %	Silt %	Clay %					
0-15	1.30	14.20	25.30	59.20	20.46	1.18	24.36	20.46	1.18
15-30	1.61	17.29	29.80	51.30	19.23	1.21	22.89	19.23	1.21
30-45	2.82	18.60	29.08	49.50	18.72	1.25	22.29	18.72	1.25
45-60	3.19	17.92	31.51	47.38	17.48	1.29	20.80	17.48	1.29
Mean	2.23	17.00	28.92	51.85	18.97	1.23	22.59	18.97	1.23

Where
F.C = Soil field capacity
P.W.P = Permanent wilting point
Bd = Soil bulk density
A.W = Available water

Table (2): The mean values of some chemical properties of the studied site before wheat cultivation in the two growing seasons.

Soil depth, cm	EC mmhos/cm at 25°C	pH soil suspension1:2.5	SAR	Soluble cations meq/L				Soluble anions meq/L			
				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{--}	HCO_3^{-}	Cl^{-}	SO_4^{--}
0-15	2.62	8.10	6.98	5.0	5.0	15.6	0.65	-	9.50	3.70	13.05
15-30	2.83	8.10	8.05	3.6	6.4	18.0	0.28	-	9.20	10.00	9.08
30-45	3.70	7.90	10.12	5.2	6.8	24.8	0.28	-	13.50	14.80	8.78
45-60	3.70	7.70	4.81	7.0	14.0	15.6	0.37	-	10.50	16.50	9.97
Mean	3.21	7.95	7.19	5.2	8.05	18.5	0.40	-	10.68	11.25	10.22

SO_4^{--}estimated by difference

Some chemical and physical properties of the studied site:

Some chemical properties were determined according to Black *et al.* (1965). Physical properties such as field capacity (FC) was determined at the site. Permanent wilting point (P.W.P.) was determined according to James (1988) and soil bulk density was determined according to Vomocil (1957). The particle size distribution was determined according to the international method (Klute, 1962). the soil is clayey in texture and the soil profile is uniform without distinct change in texture.

Execution and data collected

Irrigation control:

Application of irrigation water was controlled and measured by rectangular constructed weir fixed upstream with a discharge rate of 0.01654 m^3/sec at 10 cm as effective head over the crest.

$$Q = 1.84\ LH^{1.5}$$

Where:

Q = Discharge in $m^3\ sec^{-1}$

L = length of weir in (m)

H = Effective head (m)

Water consumptive use:

To compute the actual consumed water of the growing plants; soil moisture percentage was determined (on weight basis) before and after each irrigation as well as at harvest. Soil samples were taken from successive layers in the effective root zone (0-15, 15-30, 30-45 and 45-60 cm). This is a direct method for calculating water consumptive use based on soil moisture depletion (SMD) or actual crop water consumed (ET_c) as stated by Hansen *et al.* (1979)

$$Cu = SMD = \sum_{i=1}^{i=n} \frac{\theta 2 - \theta 1}{100} \times Dbi \times Di$$

Where:

Cu	=	Water consumptive use (cm) in the effective root zone of 60 cm depth.
SMD	=	Soil moisture depletion
i	=	Number of soil layers (1-4)
Di	=	soil layer thickness (15 cm)
Dbi	=	Bulk density (Kg m^{-3}) of the layer
θ_1	=	Soil moisture percentage before the next irrigation, and
θ_2	=	Soil moisture percentage, 48 hours after irrigation.

Crop water use efficiency:

Crop water use efficiency was calculated according to Doorenbos and Pruitt (1975) as follows

$$WutE = Y/Wa \qquad WusE = Y/Cu$$

Where:

WutE	=	Water utilization efficiency (kg m^{-3})
WusE	=	Water use efficiency (kg m^{-3})
Y	=	Marketable yield kg fed^{-1}
Wa	=	Seasonal water applied (m^3 $Fed.^{-1}$) and
Cu	=	Water consumptive use (m^3 $Fed.^{-1}$)

Yield and its components:

- Grain yield (kg/fed.)

- Straw yield (kg/fed.)
- 1000-grain weight (g)
- Biological yield (grain + straw)
- Harvest index = grain yield / biological yield (grain + straw)

The obtained data of crop yield was subjected to statistical analysis according to Snedecor and Cochran (1980) and the mean values were compared by L.S.D. at 5% and 1% levels of probability.

RESULTS AND DISCUSSION

Irrigation water applied (IW):

Irrigation water applied consists of two components, irrigation water (IW) and rainfall (Rf) as described in Table (3).

Table (3): Seasonal water applied (I.W., irrigation water, RF, rainfall) for wheat expressed in $m^3Fed.^{-1}$ and cm as affected by surface irrigation methods and fertilization in the two growing seasons.

Water applied	Treatments							
	A_1B_1	A_1B_2	A_1B_3	A_1B_4	A_2B_1	A_2B_2	A_2B_3	A_2B_4
	Season 2008/2009							
I.W. m^3/fed	2573.19	2573.19	2573.19	2573.19	2461.15	2461.15	2461.15	2461.15
I.W. cm/fed	61.27	61.27	61.27	61.27	58.60	58.60	58.60	58.60
RF, m^3/fed	→142.8←							
RF, cm/fed	→3.4←							
	Season (2009/2010)							
I.W. m^3/fed	2495.12	2495.12	2495.12	2495.12	2398.10	2398.10	2398.10	2398.10
I.W. cm/fed	59.41	59.41	59.41	59.41	57.10	57.10	57.10	57.10
RF, m^3/fed	→162.96←							
RF, cm/fed	→3.88←							
	Mean of two seasons							
I.W. m^3/fed	2534.16	2534.16	2534.16	2534.16	2429.62	2429.62	2429.62	2429.62
I.W. cm/fed	60.34	60.34	60.34	60.34	57.85	57.85	57.85	57.85
RF, m^3/fed	→152.90←							
RF, cm/fed	→3.64←							

The mean value for seasonal rainfall in the two growing seasons is 152.9 $m^3Fed.^{-1}$ or 3.64 cm/fed. presented data in Table (3) clearly showed that the mean values of irrigation water applied were affected by surface irrigation methods where the highest value was recorded under local surface irrigation comparing with corrugation one and the mean values in the two growing seasons are 2534.16 and 2429.62 $m^3Fed.^{-1}$ under basin and corrugation methods, respectively. Increasing amount of applied water under local surface method might be due to increasing timing of irrigation because the soil surface covers with water in comparison with corrugation method. Data in the same table illustrated that the values of applied water haven't been affected by fertilization treatments in the two growing seasons. These results are in a great harmony with those obtained by Samiha *et al.* (2008).

Water consumptive use:

Presented data in Table (4) clearly showed that the values of water consumptive use were affected by surface irrigation methods. Generally, the values of water consumptive use were higher under basin irrigation method comparing with corrugation one, where the mean values in the two growing seasons are 54.38, 53.15, 56.15, 58.64 and 53.41, 51.42, 56.37 and 57.13cm under A_1B_1, A_1B_2, A_1B_3, A_1B_4 and A_2B_1, A_2B_2, A_2B_3 and A_2B_4 under local surface irrigation method and corrugation one, respectively. Data also showed that the highest mean values were recorded under A_1B_4 and A_2B_4 in the two growing seasons and the mean values are 58.64 and 57.13 cm, respectively. Also, data in the same table clearly illustrated that the fertilization has a great effect on water consumptive use in the two growing seasons where the highest mean values were recorded under fertilization treatment B_4 comparing with other treatments.

The higher values of water consumptive use under basin irrigation method and B_4 fertilization treatment might be due to the better growth of plants under these conditions is very good and higher amount of applied water. So, plants supplied their nutritional requirements easily, therefore, formed strong plants with a condensed canopy and hence, amount of water consumed is high under these conditions. These results are in a great harmony with those obtained by Abd El-Rahman (2009)

Table (4): Seasonal water consumptive use (Cu) for wheat expressed in cm Fed^{-1} as affected by surface irrigation method and fertilization in the two growing seasons.

	Treatments							
	A_1B_1	**A_1B_2**	**A_1B_3**	**A_1B_4**	**A_2B_1**	**A_2B_2**	**A_2B_3**	**A_2B_4**
	Season 2008/2009							
Cu, cm	55.11	54.19	57.12	59.18	54.67	52.13	57.15	58.11
	Season (2009/2010)							
Cu, cm	53.66	52.10	55.17	58.10	52.15	50.71	55.60	56.15
	Mean of two seasons							
Cu, cm	54.38	53.15	56.15	58.64	53.41	51.42	56.37	57.13

Field and crop water use efficiency:

Presented data in Table (5) showed that the mean values of water utilization efficiency (W.Ut.E) were increased under corrugation irrigation method comparing with basin irrigation one in the two growing seasons. Also, data in the same table illustrated that the highest mean values were recorded under fertilization treatment B_4 in the two growing seasons and the mean values are 1.39 and 1.43 kg m^{-3} with A_1B_4 and A_2B_4 under surface and corrugation irrigation methods, respectively.

Concerning with water use efficiency (W.U.E.) in Table (6), data showed that the highest mean values were recorded under A_1B_4 and A_2B_4 and these values are 1.43 and 1.45 kg m^{-3} under basin and corrugation irrigation methods, respectively. These results are in a great harmony with those obtained by Abd El-Rahman (2009).

Table (5): Effect of surface irrigation methods and fertilization treatments on water utilization efficiency in the two growing seasons.

	Treatments							
	A_1B_1	A_1B_2	A_1B_3	A_1B_4	A_2B_1	A_2B_2	A_2B_3	A_2B_4
	Season 2008/2009							
WutE E, kg/m^3	1.10	1.11	1.26	1.39	1.11	1.13	1.27	1.42
	Season (2009/2010)							
WutE E, kg/m^3	1.10	1.13	1.27	1.38	1.13	1.14	1.27	1.43
	Mean of two seasons							
WutE E, kg/m^3	1.10	1.12	1.27	1.39	1.12	1.14	1.27	1.43

Table (6): Effect of surface irrigation methods and fertilization treatments on water use efficiency in the two growing seasons.

	Treatments							
	A_1B_1	A_1b_2	A_1B_3	A_1B_4	A_2B_1	A_2B_2	A_2B_3	A_2B_4
	Season 2008/2009							
WUE, kg/m^3	1.22	1.25	1.35	1.44	1.19	1.27	1.30	1.44
	Season (2009/2010)							
WUE, kg/m^3	1.22	1.29	1.37	1.41	1.23	1.28	1.30	1.45
	Mean of two seasons							
WUE, kg/m^3	1.22	1.27	1.36	1.43	1.21	1.28	1.30	1.45

Grain yield (kg/fed)

Data in Table (7) clearly illustrated that the mean values of wheat grain yield were affected by surface irrigation methods where the highest mean values were recorded under basin irrigation comparing with corrugation method. The mean values are 3121.33, 3044.33 and 3031.17 and 2972.83 kg fed.$^{-1}$ for surface and corrugation in the first and second growing seasons, respectively.

Table (7): Effect of surface irrigation methods and fertilization treatments on wheat grain yield (kg fed.$^{-1}$) in the two growing seasons

Irrigation treatments / Fertilization	Surface irrigation methods (I)					
	1st season			2nd season		
	Basin irrigation	Corrugation irrigation	Mean	Basin irrigation	Corrugation irrigation	Mean
B_1	2826.67 c	2722.67 c	2774.67 c	2742.00 d	2701.00 c	2721.50
B_2	2852.00 c	2776.67 c	2814.33 c	2817.00 c	2735.67 c	2776.33
B_3	3233.33 b	3120.00 b	3176.67 b	3175.00 b	3036.67 b	3105.83
B_4	3573.33 a	3505.33 a	3539.33 a	3443.33 a	3418.00 a	3430.67
Mean	3121.33	3031.17	3076.25	3044.33	2972.83	3008.58
Comparison	**S.E.D.**	**L.S.D. 5%**	**L.S.D. 1%**	**S.E.D.**	**L.S.D. 5%**	**L.S.D. 1%**
2 B means at each I	32.47	70.74	99.16	18.27	39.80	55.79
2 B means	22.96	50.02	70.12			

In a column, means followed by a common letter are not significant different at the 5% level of significancy by DMRT

Increasing wheat grain yield under basin irrigation comparing with corrugation one, might be due to increasing the amount of applied water under these conditions, consequently, plants take their water and nutritional requirements comparing with corrugation one, therefore these conditions create good growth and increase yield due to increasing the amount of uptake elements uptake will increase. So, formed filling grains in comparison with corrugation method which it received less amount of irrigation water. So, plants will be weak therefore, decreasing grain yield. These results are in a great harmony with those obtained by Arancon *et al.*, (2006).

Concerning with, the effect of fertilization, the highest mean values in the two growing seasons were recorded under B_4 fertilization treatment comparison with the other fertilization treatments. The values of wheat grain yield can be descended in order B_4>B_3>B_2>B_1 under the two irrigation methods but similar to the abovementioned facts which the mean values under local surface irrigation methods were higher than those under corrugation one.

Increasing wheat grain yield under B_4 fertilization treatment might be due to application of microbial inoculants and humates formed strong plant growth formed with good spikes which gave a good yield comparing with other fertilization treatments. Also, applying microbial inoculants and humates increased activity of soil microorganisms that decompose soil organic matter which improves soil properties and reflected on the yield. These results are in a great harmony with those obtained by Melero *et al.* (2007)

Straw yield (kg fed.$^{-1}$)

Data in Table (8) showed that the mean values of wheat straw yield were clearly affected by irrigation methods where the highest mean values in the two growing seasons were recorded under basin irrigation method comparing with corrugation one. The highest mean values are 5759.50, 5705.42 and 5712.17, 5652.58 kg fed^{-1} for basin and corrugation methods in the first and second growing seasons, respectively.

Table (8): Effect of surface irrigation methods and fertilization treatments on wheat straw yield (kg fed^{-1}) in the two growing seasons

Irrigation treatments / Fertilization	Surface irrigation method (I)					
	1st season			2nd season		
	Basin irrigation	Corrugation irrigation	Mean	Basin irrigation	Corrugation irrigation	Mean
B_1	5523.33 b	5310.67 c	5417.00 b	5506.33 b	5260.33 c	5383.33 b
B_2	5511.33 b	5650.00 b	5580.67 b	5461.00 b	5566.67 bc	5513.83 b
B_3	5940.00 a	5860.00 ab	5900.00 a	5887.00 a	5792.00 ab	5839.50 a
B_4	6063.33 a	6028.00 a	6045.67 a	5967.33 a	5991.33 a	5979.33 a
Mean	5759.50	5712.17	5735.83	5705.42	5652.58	5679.00
Comparison	**S.E.D.**	**L.S.D. 5%**	**L.S.D. 1%**	**S.E.D.**	**L.S.D. 5%**	**L.S.D. 1%**
2 B means at each I	134.45	292.95	410.63	142.66	310.84	435.71
2 B means	95.07	207.15	290.36	100.88	219.80	308.09

In a column, means followed by a common letter are not significant different at the 5% level of significancy by DMRT

These results are in a great harmony with those obtained by Tavakkoli and Oweis (2004). Also, data in the same table illustrated that the fertilization treatments have a great effect on wheat straw yield in both growing seasons, where the highest mean values were recorded under B_4 treatment comparing with other treatments. Generally, the mean values of straw yield can be descended in order in both growing seasons $B_4 > B_3 > B_2 > B_1$. These results are in a great agreement with those obtained by Arduini *et al.* (2006).

Biological yield (kg fed^{-1}):

Biological yield means the sum of both grain and straw yields. Tabulated data in Table (9) showed that the mean values of biological yield were increased under basin irrigation method comparing with corrugation one where the lowest mean values are 8743.33, 8626.92 and 8880.83 and 8749.75 kg/fed. under corrugation and basin irrigation methods in the first and second growing seasons, respectively. This might be due to increasing both grain and straw yield under surface irrigation. Data in the same table illustrated that the mean values of biological yield were greatly affected by fertilization treatments where the highest mean values were recorded under B_4 treatment in the two seasons. This might be due to improving soil properties under the conditions of this treatment and hence increasing both grain and straw yield. Generally, the mean values of biological yield can be descended in order $B_4 > B_3 > B_2 > B_1$ in the two seasons.

Table (9): Effect of surface irrigation methods and fertilization treatments on wheat biologial yield (kg fed^{-1}) in the two growing seasons

Irrigation treatments / Fertilization	Surface irrigation method (I)					
	1st season			2nd season		
	Basin irrigation	Corrugation irrigation	Mean	Basin irrigation	Corrugation irrigation	Mean
B1	8350.00 c	8033.33 d	8191.67 c	8248.33 c	7967.33 d	8107.83 c
B2	8363.33 c	8426.67 c	8395.00 c	8278.00 c	8302.33 c	8290.17 c
B3	9173.33 b	8980.00 b	9076.67 b	9062.00 b	8828.67 b	8945.33 b
B4	9636.67 a	9533.33 a	9585.00 a	9410.67 a	9409.33 a	9410.00 a
Mean	8880.83	8743.33	8812.08	8749.75	8626.92	8688.33
Comparison	S.E.D.	L.S.D. 5%	L.S.D. 1%	S.E.D.	L.S.D. 5%	L.S.D. 1%
2 B means at each I	146.90	320.08	448.65	141.41	308.11	431.88
2 B means	103.87	226.33	317.25	99.99	217.87	305.39

In a column, means followed by a common letter are not significant different at the 5% level of significancy by DMRT

Harvest index and weight of 1000-grain

Presented data in Tables (10 and 11) were significantly affected by surface irrigation methods under study where the highest mean values for the two studied parameters were increased under basin irrigation method comparing with corrugation one in the two growing seasons. These results are in a great agreement with those obtained by Arancon *et al.* (2006).

Data in the same tables showed that the mean values for the two studied parameters were increased under the conditions of B_4 treatment in the two growing seasons and the mean values for the two parameters can be descended in order $B_4>B_3>B_2>B_1$.

Table (10): Effect of surface irrigation methods and fertilization treatments on wheat harvest index in the two growing seasons

Irrigation treatments / Fertilization	Surface irrigation method (I)					
	1st season			2nd season		
	Basin irrigation	Corrugation irrigation	Mean	Basin irrigation	Corrugation irrigation	Mean
B_1	33.857 c	33.900 bc	33.878 c	33.253 c	33.940 bc	33.597 c
B_2	34.117 bc	32.950 c	33.533 c	33.540 c	32.947 c	33.243 c
B_3	35.247 b	34.740 b	34.993 b	35.037 b	34.390 b	34.713 b
B_4	37.080 a	36.770 a	36.925 a	36.583 a	36.333 a	36.458 a
Mean	35.075	34.590	34.833	36.603	34.403	34.503
Comparison	**S.E.D.**	**L.S.D. 5%**	**L.S.D. 1%**	**S.E.D.**	**L.S.D. 5%**	**L.S.D. 1%**
2 B means at each I	0.527	1.149	1.610	0.556	1.212	1.699
2 B means	0.373	0.812	1.390	0.393	0.857	1.201

In a column, means followed by a common letter are not significant different at the 5% level of significancy by DMRT

Table (11): Effect of surface irrigation methods and fertilization treatments on wheat 1000 grain weight in the two growing seasons

Irrigation treatments / Fertilization	Surface irrigation method (I)					
	1st season			2nd season		
	Basin irrigation	Corrugation irrigation	Mean	Basin irrigation	Corrugation irrigation	Mean
B_1	51.400 c	51.133 c	51.267 c	50.800 c	51.500 c	51.150 c
B_2	51.467 c	51.400 c	51.433 c	51.000 c	51.167 c	51.083 c
B_3	52.567 b	52.333 b	52.450 b	52.133 b	52.033 b	52.083 b
B_4	53.567 a	53.367 a	53.467 a	53.067 a	53.000 a	53.033 a
Mean	52.250	52.058	52.154	51.750	51.925	51.838
Comparison	**S.E.D.**	**L.S.D. 5%**	**L.S.D. 1%**	**S.E.D.**	**L.S.D. 5%**	**L.S.D. 1%**
2 B means at each I	0.289	0.631	0.884	0.223	0.486	0.682
2 B means	0.205	0.446	0.625	0.158	0.344	0.482

In a column, means followed by a common letter are not significant different at the 5% level of significancy by DMRT

REFERENCES

Abd El-Rahman, G. (2009). Water use efficiency of wheat under drip irrigation systems at Al-Maghara Area, North Sinai, Egypt. American Eurasian J. Agric. & Environ Sci. 5(5): 664-670.

Arancon, N.Q.; Edwards, C.A.; Lef, S. and Byrne, R. (2006). Effects of humic acids from vermicomposts on plant growth. Soil Bio. 42: 565-569.

Arduini, I.; Masoni, A.; Ercoli, L. and Mariotti, M. (2006). Grain yield and dry matter and nitrogen accumulation and remobilization in durum wheat as affected by variety and seeding rate. Europ. J. Agron. 25: 309-318.

Black, C.A.; Evans D.D.; Ensmigger L.E., White, J.L. and Clark, F.E. (1965). Methods of soil analysis. Amer. Soc. Agron. Inc., Madison Wisconsin USA.

Chefetz, B.; Tarchitzky, J.; Deshmukh, A.P.; Hatcher, P.G. & Chen, Y. (2000). Structural characterization of soil organic matter and humic acids in particle size fractions of an agricultural soil. Soil Sci. Am. J. 66: 129-141.

Doorenbos, J. and Pruitt, w.O. (1975). Crop water requirements. Irrigation and drainage paper. No. 24, FAO, Rome.

Hansen, V.W.; Israelsen and Stringharm, Q.E. (1979). Irrigation principles and practices, 4th ed., John Willey and Sons New York.

James, L.G. (1988). Principles of farm irrigation system design. John Willey and Sons (Ed.), New York, pp. 543.

Klute, A. (1962). Methods of soil analysis part 1, "physical and mineralogical methods" with Madison Wisconsin, USA.

Melero, S.; Madejon, E.; Ruiz, J.C. and Herenncia, J.F. (2007). Chemical and biochemical properties of clay soil under dry land agriculture system as affected by organic fertilization. Eurp. J. Agron., 26: 327-334.

Samiha, A. Ouda; Khalil, F.A.; Rashad, A.E.; Sherief, M.A.K.; Bogachan, B.E.N.L. and Odir, M.Q.(2008). Using yield stress model in irrigation management for wheat grown in Egypt. Journal of Applied Biology Science, 2(1): 57-65.

Snedecor, W.G. and Cochran, W.G. (1980). Statistical Methods 6th ed. Iowa State Univ. USA.

Tavakkoli, A.R. and Oweis, T.Y. (2004). The role of supplemental irrigation and nitrogen in producing bread wheat in the highlands of Iran. Agric. Water. Manage. 65: 225-236.

Vomocil, J.A. (1957). Measurements of soil bulk density and penetrability. A review of methods Adv. Agric., 9, New York, London, Edited by Norman a.g. pp. 159-176.

ترشيد مياه الرى والاسمدة النتروجينية لمحصول القمح باستعمال اللقاحات الميكروبية تحت طريقتين من الرى السطحى

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أجريت تجربتان حقليتان بالمزرعة البحثية بمحطة البحوث الزراعية بسخا. محافظة كفرالشيخ بمنطقة شمال دلتا النيل خلال موسمى النمو الشتوى 2009/2008 ، 2010/2009 وكان الهدف من الدراسة هو تقليل كمية الاسمدة النتروجينية باستخدام البكتريا المثبتة للأزوت واللقاحات الميكروبية وتأثيراتها على انتاجية القمح تحت طريقتين من طرق الري السطحى. أيضا يهدف هذا العمل الى مقارنة طريقتى الرى السطحى لرى القمح. لتحديد أفضل تلك الطرق من حيث تحقيق أعلى انتاجية وكذلك ترشيد الماء المستهلك ودراسة بعض العلاقات المائية. و كان التصميم الاحصائى هو نظام القطع المنشقه مرة واحدة بأربع مكررات.

وكانت المعاملات الرئيسة هى طرق الرى أ$_1$ رى سطحى عادى ، أ$_2$ رى الاخاديد بينما كانت المعاملات تحت الرئيسة عبارة عن معاملات التسميد واضافة اللقاحات الميكروبية وهي ب$_1$ نتروجين معدنى ، ب$_2$ تحليل التربة والوصول الى المعدل الموصىبه ، ب$_3$ اضافة 50 وحدة أزوت للفدان + لقاح حيوى ، ب$_4$ اضافة 50 وحدة ازوت للفدان + لقاح حيوى + هيومات محملة بالعناصر الصغرى.

أهم النتائج التى تم التوصل اليها يمكن تلخيصها فيما يلى:

1- زادت قيم مياه الرى المضافة مع طريقة الرى أ$_1$ مقارنة بطريقة الري أ$_2$ كذلك أوضحت النتائج أن قيم مياه الرى المضافة لم تتأثر بمعاملات التسميد.
2- سجلت أعلى القيم بالنسبة للإستهلاك المائى مع طريقة الرى أ$_1$ فى كلا موسمى الدراسة مقارنة بطريقة الري أ$_2$ بالنسبة لتأثير التسميد سجلت أعلى القيم مع المعاملة ب$_4$ ... أوضحت النتائج كذلك أن أعلى المتوسطات سجلت مع المعاملات أ$_1$ب$_4$ ، أ$_2$ب$_4$ فى كلا موسمى الدراسة.
3- أعلى القيم بالنسبة لكفاءة استخدام واستعمال المياه سجلت مع معاملة الرى أ$_2$ بالمقارنة أ$_1$ وأعلى القيم سجلت مع المعاملات أ$_1$ب$_4$ ، أ$_2$ب$_4$.
4- أدت طريقة الري أ$_1$ إلي زيادة قيم محصول الحبوب مقارنة بطريقة الري أ$_2$ وأن أفضل معاملة تسميد هى ب$_4$.
5- أن إستخدام طريقة الري أ$_1$ ادت الى زيادة محصول القش، المحصول البيولوجي، دليل الحصاد، ووزن 1000 حبة مقارنة بطريقة الري أ$_2$ فى كلا موسمى الدراسة. أيضا زادت هذة المقاييس مع معاملة التسميد ب$_4$ ويمكن ترتيب هذة القيم تنازليا فيمايلي: ب$_4$ > ب$_3$ > ب$_2$ > ب$_1$.

قام بتحكيم البحث

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