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Influence of Different Tillage Systems and Fertilization Regimes on Wheat Yield, Wheat Components and Water Use Efficiency

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FIELD experiment was carried out in the season of 2012/2013 at the Agriculture Experimental Station, Faculty of Agriculture, Cairo University to compare the effect of different fertilizers; Bio-fertilizer at different rates (B1, B2 and B3), mineral fertilizer (F1) and combination between mineral and organic fertilizers (F2 and F3) under different tillage systems (conventional tillage (CT), reduce tillage (RT) and no-tillage (NT)) on some soil physical properties, yield, yield components of wheat, and water use efficiency. The results showed that the highest plant height, spike length, no. of grains and 1000 grain weight and grain yield were obtained under conventional tillage followed by reduce and no-tillage, respectively. The difference between CT and NT was significant, however, no significant difference was found between (RT) and each of (CT) and (NT). The results also showed that, under each tillage treatment, fertilization assured a significant increase in plant height, grain yield and yield components. The application of biofertilizer at rate of 750 gm/fad increased grain yield and the studied traits compared to mineral and organic fertilizers treatments. Using biofertilizer at rate of 750 gm/fad reduced the difference in grain and straw yield among tillage treatments. Among mineral and organic fertilizers treatments, the highest grain yield and its components were obtained with the combined treatment (75 % NP + 75 % compost).Water use efficiency (WUE) was also affected by the interaction effect between tillage systems and fertilization regimes. The highest (WUE) was obtained using CT fertilized with biofertilizer rate of 750 gm/fad. While, the lowest (WUE) was obtained using NT fertilized with mineral fertilizers only. As a conclusion, the application of appropriate rate of biofertilizer and combination treatment (75 % NP and 75 % compost) under all tillage treatments had worked out in same manner. These two fertilization treatments reduce the difference in grain yield and yield components between the no tillage and both of conventional and reduce tillage systems. Therefore, Reduce tillage and No-tillage system could be applied with the attention to the corresponding fertilization in order to increase wheat productivity.

Keywords: Conventional tillage, No tillage, Reduce tillage, Biofertilizer, Mineral fertilizer, Organic fertilizer, Wheat crop.

Sustainable agriculture is becoming very important and attractive to many farmers. It is based on integrated program includes tillage practices and fertilization regimes. Since tillage system modifies soil structure, changes many physical soil properties and affects plant growth and crop production, it is important to apply the proper tillage system. The increase in chemical fertilizers prices and the pollution problems of soil and water is a purpose to solve these problems. Therefore, fertilization regimes are also important objective in sustainable agriculture. Organic and bio-fertilizers are used as an optimal solution for overcoming these problems and in the same time sustaining soil fertility. Hammel (1989) indicated that tillage method affects the sustainable use of soil resources through its influence on soil properties. Tillage is one of the important factors that influence soil properties and crop yields. Tillage contributes up to 20 % in the crop production factors (Khurshid *et al.,* 2006). In agronomic techniques, by using high quality inputs, management practices, can raise yield per unit area (Khavazi *et al.,* 2005). Also, Ryan and Matar (1992) indicated that crop yields can be substantially improved by crop management practices and fertilizer use. Tillage in particular and soil organic matter influences many physical, chemical and biological properties (Roth *et al.,* 1992). It was found by Pavinato *et al.* (2010) and Ishaqu *et al.* (2002) that tillage management practices have a direct effect on the behavior and availability of soil nutrients. Galantini *et al.* (2000) also found a significant impact between tillage and nutrient distribution and transformation. Wilson *et al.* (2000) clarified that application of compost in combination with tillage systems improved grain and straw yield. A balanced use of fertilizers and integrated management reduced production costs and increased farming efficiency (Derpsh, 2008). No tillage or reduced tillage is used as a mean to diminish costs, and improve soil structure and maintain environment quality (Rusu *et al.,* 2011). To escape from no tillage disadvantages and save time for sowing a crop, reduced tillage may be used as an important alternative (Nawar and Khalil, 2004).

Gagnon *et al.* (1997) reported that the complete or partial replacement of NPK mineral fertilizers by the use of more safe and economical organic fertilizers is strongly recommended. The application of farmyard manure at different rates significantly increased yield and its components (Hosam El-Din, 2007). Utilize Bio-fertilizers importing a large population of effective microorganisms in the active field and root system, increase plants power to absorb more nutrients (Khavazi *et al.,* 2005).

Mitkees *et al.* (1996) reported that biofertilization with a mixture of N_2-fixing bacteria could compensate considerable parts of mineral nitrogen fertilizers, it saves about 2/3 and 1/3 of the recommended nitrogen in old and new lands, respectively. It was also found that the inoculation with biofertilization had significant effect on plant height, grains weight/spike, no. of spikes/m^2, 1000 grain weight grain and straw yield ton/fed in wheat plants (Suzan, 2007). Inoculate wheat grains with cerialine recorded the highest means values of grain yield and its major components and save about from 25 to 50 % of nitrogen cost (Sadek and Youssef, 2000 and Bassal *et al.,* 2001).

Water use efficiency is governed by soil management crop choice, fertilizer use and other agronomic techniques (Rawitz *et al.,* 1994 and Peterson & Westfall, 2004). Crop water use efficiency can by increased by 25-40 % through soil management (Hatfield *et al.,* 2001).

The objective of this study was to compare the effect of different biofertilizer, organic and mineral fertilizers and combination between them under three different tillage systems on grain yield, yield components of wheat crop, some soil physical properties and water use efficiency.

Material and Methods

This study was conducted at the Agriculture Experimental station, Faculty of Agriculture, Cairo University to compare the effect of six different fertilization regimes under three different tillage practices on some soil physical properties, plant height, grain yield, yield components, and water use efficiency of wheat (*Triticum aestivum* L.). The experimental design was split plot with three replication which included tillage practices in the main plots and fertilization regimes in the sub-plots.

The three tillage practices were: Conventional tillage (CT), chisel plough - harrowing - seedbed implement, Reduce conventional tillage (RT); chisel plough – seedbed implements, and No-tillage (NT) by direct seeding.

On the other hand, the fertilization regimes were: Biofertilizer (cerialine) which included Azotobacter and Azospirillum bacteria at three rates; 250 (B1), 500 (B2) and 750 (B3) gm/fad. Meanwhile the mineral and organic fertilizer were; the recommended dose of NP (F1), 75 % NP + 50 % compost of the recommended dose (F2) and 75 % NP + 75 % compost of the recommended dose (F3).

Grains of wheat were inoculated with cerialine shortly before sowing time. Phosphorus fertilizer was added before ploughing as calcium super phosphate (15.5 P_2O_5) at 100 kg/fad., nitrogen fertilizer in the form of urea (46 % N) at the rate of 75 kg N/fad. was added into three equal doses (at sowing time, at the first irrigation and about 25 days after the first irrigation. The recommended dose of compost was 6.0 ton/fad. Compost mixed with the soil two weeks before sowing. The chemical analysis of the applied compost is shown in Table 1.

Undisturbed soil samples were collected from the top (0-20 cm) before the establishment of the experiment to determine some physical and chemical properties of the studied soil (Table 2). Physical and chemical analyses were also carried out at the end of plant growth period to determine bulk density, total porosity and hydraulic conductivity. The physical and chemical properties were done according to Klute (1986) and Page *et al.* (1982).

Wheat grains (Skha 93) were sown broadcasting on 16 November. The area of each plot was 3.5 x 6.0 m. At harvest, one square meter was taken randomly from each subplot and the following data were recorded: plant height (cm), spike length (cm), No of grain/spike, 1000-grain weight (gm), straw yield (ton/fad), and grain yield (kg/fad).

Soil samples for moisture determinations were taken from each 15 cm depth for a total depth of 60 cm. The amount of water consumed in each irrigation was obtained from the difference between soil moisture content after and before the following irrigation. Water consumptive use was calculated according to Hansen *et al.* (1979) as follow:

$$WCU = (\theta_2 - \theta_1 /100)\, d$$

Where:

WCU: Water consumptive use in the active root zone (60 cm).

θ_2: Volumetric soil moisture content after irrigation (%).

θ_1: Volumetric soil moisture content before irrigation time (%).

d : Depth of soil layer (mm).

Water use efficiency (WUE) was calculated according to Giriappa (1983) as follows:

$$WUE = \frac{\text{Grain yield (Kg/fad)}}{\text{Water Consumptive use } (m^3/\text{fad})}$$

Analysis of variance (ANOVA) was performed to determine the separate and interaction effects of the main and sub-pots treatments on wheat yield as described by Gomez and Gomez (1984). The treatment means were compared using the least significant differences at 5 % level.

TABLE 1. Chemical analysis of the applied compost .

pH (1:10)	$EC_{1:10}$ dS/m	O.M %	Total %			ppm				
			N	P	K	Fe	Mn	Zn	Cu	C/N
6.6	1.6	58.0	1.40	0.60	0.79	630	157	40	30	18/1

Source: Delta Biotic Company.

TABLE 2. Some physical and chemical properties of the investigated soil.

Soil properties			
Physical		**Chemical**	
Bulk density ($g.Cm^{-3}$)	1.23	pH (1:2.5)	8.10
F.C (%)	35.7	ECe (dS/m)	1.73
W.P (%)	16.3	O.M (%)	1.87
Mechanical analysis (%)		Available (ppm)	
Sand	40.7	N	19.5
Silt	30.9	P	12.3
Clay	28.4	K	239.0
Texture class	Clay loam		

Results and Discussion

Effect of tillage systems

Wheat grain yield and its components as affected by tillage system are shown in Table 3. It is clear that tillage practices are significantly affected plant height, grain yield and yield components. The highest grain yield was recorded under conventional tillage (CT) followed by reduced tillage (RT) then no-tillage (NT) practices, respectively. Conventional tillage increases grain yield by 4.0 % and 9.0 % and straw yield by 5.0 and 10.0 % compared to reduce and no tillage systems, respectively. The increase in plant height, spike length, no of grains per spike and 1000 grain weight under CT are 2.8%, 6.7%, 6.8% and 4.2% compared to reduced tillage and by 5.5%, 12.0%, 15.6% and 7.7 % compared to no tillage. The grain yield obtained under NT was lower by 4.68 % comparing to RT. However no significant difference was found between RT and NT. No significant difference was found between CT and RT. And also between RT and NT, while a significant difference between CT and NT was found.

TABLE 3. Effect of unfertilized tillage treatments on plant height, grain yield and its components.

Tillage treatments	Plant height (cm)	Spike length (cm)	No. of grains/ spike	1000 grain wheat (gm)	Straw yield ton/fad	Grain yield Kg/Fad
CT	86.59	14.16	71.39	46.13	2.67	2281.4
RT	83.23	13.27	66.83	44.25	2.54	2195.1
NT	81.14	12.64	61.74	42.84	2.42	2092.5
L.S.D 5%	3.90	2.26	3.69	2.04	0.14	132.9

The variations in plant height, grain yield and yield components under different tillage systems is due to the changes in physical properties of the soil that resulted from tillage practices. The differences under tillage systems and fertilization treatments in the values of soil bulk density (BD), total porosity (TP) and hydraulic conductivity (HC) are reported in Table 4 . It was evident that CT produced the most favorable soil physical properties for wheat growth as it reduce soil bulk density, increased total porosity and the hydraulic conductivity. Meanwhile, No tillage system led to the highest bulk density and the lowest decreasing soil hydraulic conductivity comparing with conventional tillage. Dormaeer (1990) found that soil porosity and its capacity of mineralization of the applied fertilizer diminished under no tillage system.

Determination of soil bulk density has shown that its values were varied between 1.27 to 1.31 g.cm^{-3} according to tillage system. The lowest value is recorded under CT whereas; the highest value is recorded under NT. The mean (BD) values were higher under NT by 3.1 % and 2.3 % than under CT and RT, respectively. Total porosity values were also affected by tillage system. Conventional tillage recorded the highest values followed by reduce tillage then no tillage, respectively. Hydraulic conductivity values were also higher under CT compared to RT and NT. Khan *et al.* (1999) reported that conservation tillage may reduce disruption of continues pores whereas, conventional tillage decreases soil bulk density. The decrease of bulk density and the increase of total porosity and hydraulic conductivity values under CT lead to a favorable environment for crop growth and nutrient use. Khan *et al.* (2001) and Hajabbasi & Hemmat,

(2000) reported that unsuitable soil physical properties in reduced tillage and no tillage treatments limit crop growth and subsequently grain yield. Sundermeier *et al.* (2011) also indicated that, type and intensity of tillage affects the agricultural sustainability through its influence on soil properties.

TABLE 4. Mean values of the studied soil physical properties as affected by tillage systems and fertilization regimes.

Tillage treatments	Fertilizer treatments	Physical properties		
		BD $g.cm^{-3}$	TP %	HC Cm/h
CT	B	1.26	52.84	0.34
	F	1.27	52.37	0.32
	Mean	1.27	52.61	0.33
RT	B	1.27	51.56	0.32
	F	1.29	51.30	0.30
	Mean	1.28	51.43	0.31
NT	B	1.30	50.14	0.28
	F	1.32	50.61	0.26
	Mean	1.31	50. 38	0.27
L.S.D 5%		0.02	ns	0.04

When comparing the fertilized tillage treatments (Tables 5 & 6) with the unfertilized tillage treatments (Table 3), the fertilized tillage treatments with either biofertilizer or mineral and organic fertilizers produced higher grain and straw yield and increased plant height and yield attributes compared to unfertilized tillage treatments. Fertilized tillage treatments also affect physical properties of the soil. The biofertilizer treatments reduced bulk density and increased both total porosity and hydraulic conductivity followed by mineral and organic fertilizers treatments. These may be due to increase the microbiological activity which produce organic acids encourage the aggregation formation consequently increase the total porosity, decrease the soil bulk density and increase the macro pores in turn increase the hydraulic conductivity.

Effect of biofertilizer

The effect of biofertilization on wheat yield and its components was given in Tables 5 & 6. The results revealed surpass of biofertilizer on the mineral fertilizers. The highest biofertilizer rate (B_3) produced the highest grain yield and yield components. The average increase in grain yield with B_3 compared to B_1 was 15.7 %, 17.3 and 16.1 % under CT, RT and NT, respectively. Biofertilizers help to enhance the growth of plants by production of various growth hormones and provision of essential nutrients. These results were in agreement with Suzan (2007) and Al-Taweil *et al.* (2009) who found that Azotobacter not only provides nitrogen, but also produces a variety of growth, promoting substances which, stimulate at least to some degree, the production of root exudates which in turn affect their numbers. The results showed that there was reduction in grain yield and yield components with B_1 as compared to mineral fertilization. These results indicate that at lower rate of biofertilizer (250 gm/fad) could not meet the NPK effect.

TABLE 5. Grain and straw yield as affected by tillage practices and fertilization treatments.

Fertilization treatments	Tillage practices					
	CT	RT	NT	CT	RT	NT
	Grain yield (ton/fad)			Straw yield (ton/fad)		
B_1	2.29	2.18	2.13	2.78	2.71	2.58
B_2	2.51	2.45	2.37	2.90	2.80	2.73
B_3	2.64	2.56	2.47	3.35	3.20	2.98
Mean	2.48	2.40	2.33	3.01	2.90	2.76
F_1	2.30	2.28	2.13	2.82	2.77	2.62
F_2	2.44	2.32	2.21	3.10	2.86	2.76
F_3	2.56	2.46	2.35	3.29	2.97	2.88
Mean	2.43	2.35	2.23	3.07	2.87	2.75
L.S.D $_{0.05}$	0.190	0.146	0.161	ns	ns	ns

TABLE 6. Plant height and studied yield components as affected by different tillage systems and fertilization regimes.

Tillage treatments	Fertilization treatments	Plant height (cm)	Spike length (cm)	No. of grains/ spike	1000 grain wheat (gm)
CT	B_1	92.56	15.83	72.91	46.19
	B_2	95.43	16.69	77.9	48.65
	B_3	101.23	17.81	80.12	50.17
	Mean	96.41	16.78	76.98	48.34
CT	F_1	94.20	15.98	74.82	47.75
	F_2	94.81	16.52	76.82	49.11
	F_3	99.45	17.58	78.72	49.67
	Mean	96.15	16.69	76.79	48.84
RT	B_1	88.14	14.94	63.56	45.62
	B_2	92.12	16.21	68.51	47.85
	B_3	97.53	17.30	72.30	51.27
	Mean	92.59	16.15	68.12	48.25
RT	F_1	90.35	15.45	66.51	46.15
	F_2	92.62	15.92	68.75	48.14
	F_3	95.61	16.86	70.98	50.40
	Mean	92.86	16.08	68.75	48.29
NT	B_1	84.0	14.25	59.66	43.19
	B_2	87.9	15.51	63.97	45.82
	B_3	94.62	16.56	67.17	48.13
	Mean	88.84	15.44	63.60	45.71
NT	F_1	85.31	14.97	61.59	44.74
	F_2	88.47	15.58	64.15	46.13
	F_3	92.13	15.96	66.75	47.55
	Mean	88.64	15.50	64.16	46.14
L.S.D $_{0.05}$	CT x B x F	2.41	ns	3.16	2.29
	RT x B x F	3.04	ns	4.12	2.31
	NT x B x F	3.77	ns	3.75	2.43
	T x B x F	2.92	ns	3.44	2.12

Statistically, a significant difference was obtained between B_1 and each of B_2 and B_3 on plant height, no. of grains and grain yield. While, no significant difference was found on 1000 grain weight, spike length and straw yield. On the other hand, when comparing between wheat yields inoculated with the highest biofertilizer rate and the grain yield obtained with mineral-organic fertilizers, no significant difference was found. The same results were obtained with plant height, spike length, no. of grain/spike and 1000 grain weight. The application of appropriate concentration of biofertilizer and mineral –organic fertilizers had worked out in same manner. Mahmoud *et al.* (2009) found that combined application of organic and inorganic fertilizers increases plant growth, yield quality and soil fertility for plants.

Effect of mineral and organic fertilizers

Data presented in Tables 5 & 6 show the values of plant height, spike length, no. of grains/spike, grain yield and straw yield. The results visibly indicate that adding mineral fertilizers alone did not (significantly) increase wheat yield and its attributes compared to chemical and organic fertilizers combination. This is due to the direct contribution of organic fertilizer to many physical, chemical and biological properties of the soil. Burger and Jackson (2003) stated that chemical fertilizer facilitate higher plant growth, but when compared to the organic manure it is less effective. The highest values of plant height, spike length, 1000 grain weight, grain and straw yield are obtained with (F_3) followed by (F_2) and (F_1) respectively. Statistically no significant difference between F_1 and F_2 on plant height, yield and yield components was found. A significant difference was found between F_3 and each of F_1 and F_2 on plant height.

Increasing percentage of organic fertilizer increased grain and straw yields. This increase could be due to the significant increase in spike length, no of grains per spike and 1000 grain weight. Several authors pointed out the capability of organic manure for improving growth and production of cereal. These results are in agreement with Mustatea *et al.* (2009) and Voica (2009).

Comparing between, mineral- organic treatments (F_1 and F_2) and bio-fertilizer treatments, under each tillage treatments, a significant difference was obtained between each of F_1 and F_2 and biofertilizer treatment (B_3) while, no significant difference was found with F_3.

Effect of interactions

The interaction effect between tillage and fertilization treatments (Table 5 & 6) show that under all tillage treatments the highest values of grain yield and yield components were produced from wheat inoculated with Bio-fertilizer at higher rate compared to mineral and organic fertilization treatments. The application of CT and RT combined with biofertilizer increased grain and straw yield significantly compared to NT. However, inoculation wheat grain with 750 gm/fad reduced the difference in mean grain yield between NT and other tillage systems. In the no-tillage system, the wheat yield also increased in accordance to fertilization rate from B_1 to B_3 and from F_1 to F_3 respectively. Fertilizer application is an important management factor in no-tillage system. Feiza *et al.* (2003) indicated that the lower productivity induced by the use of a conservation agriculture system could be balanced by using fertilizers.

The effects of interaction between tillage and fertilizers on plant height, spike length, no. of grains and 1000 grains weight are similar as grain yield. The data also show that no significant difference was found between RT and NT fertilized with biofertilizer.

The grain yield due to the amount of fertilizers applied varied between fertilization treatments. Application of 75% NP + 75 % compost significantly increased the studied traits than those fertilized with 250 and 500 kg/fad.

Grain content of NPK

The content of N, P and K in wheat grains as affected by tillage and fertilization regimes were shown in Table 7. The data revealed that mineral and the combination of mineral and organic fertilizers increase nitrogen, phosphorus and potassium in grains comparing to B1 and B2, respectively. Whereas, increasing inoculation rate to B_3 increased N, P and K content in grains more than F_1, F_2 and F_3. These results indicate that increasing biofertilizer rate up to 750 gm/fad encourage the uptake of various elements. The results also show that F3 is more efficient than F_1 and F_2. Patel *et al.* (1996) stated that inoculation of wheat plants with Azospirillum, Azotobacter strains increased N uptake in plants. However, no significant difference was found between biofertilizers at different rates and each of mineral and mineral + organic fertilizers treatments. El-Metwally (2007) also indicated that combination of organic input and application of chemical fertilizers was achieving a balance nutrient supply. The interaction between tillage systems and fertilization regimes increase the effect of both tillage and different fertilizers on N, P and K content in grains of wheat. The highest content of N, P and K was obtained with 750 gm/fad under CT tillage treatment. The positive effect of tillage and inoculation upon nutrient uptake could be attributed to the increase in the root surface per unit of soil volume under conventional tillage, the high the efficiency of bacteria presence in biofertilizer cerialine- to fix atmospheric nitrogen- the increase in biologically active capacity of the plants in building metabolites which might contribute to the increase nutrients uptake by plants. The lower content of N, P and K under no tillage system may be due to the effect on soil physical properties as the increase in soil bulk density and soil compaction, which may negatively influence nutrients uptake with poor performance of root growth.

Water consumptive use

The results in Table 8 show the water consumptive use values by wheat plants under different tillage systems and fertilization regimes. Data show that water consumptive use influenced by tillage systems as the conventional tillage consumed water more than reduced and no-tillage systems. The decrease in water consumption under (NT) may be attributed in part to a lower evaporation rate and also to the low plant growth (Bergh *et al.,* 1995). The data also, show that consumption of water increased with the increase in fertility levels. The highest values of water consumptive use are obtained under B_3 followed by F_3, respectively. These results may be due to improved vegetative growth and root system, which enabled the plant to utilize more moisture from soil layers.

TABLE 7. Nitrogen, Phosphorous and Potassium of wheat grains as affected by tillage systems and fertilization regimes .

Fertilization treatments	Tillage systems								
	CT			RT			NT		
	N%	P%	K%	N%	P%	K%	N%	P%	K%
B_1	1.92	0.24	0.51	1.79	0.19	0.47	1.72	0.18	0.40
B_2	2.15	0.26	0.54	1.87	0.23	0.51	1.79	0.19	0.45
B_3	2.23	0.37	0.62	2.13	0.28	0.57	1.97	0.25	0.51
Mean	2.10	0.29	0.56	1.93	0.23	0.52	1.83	0.21	0.45
F_1	2.26	0.28	0.57	1.87	0.21	0.49	1.81	0.19	0.44
F_2	2.25	0.29	0.56	1.91	0.24	0.54	1.84	0.23	0.43
F_3	1.96	0.36	0.59	2.07	0.26	0.56	1.91	0.24	0.47
Mean	2.16	0.30	0.57	1.95	0.24	0.53	1.85	0.22	0.45
L.S.D 5 %	0.243	0.091	0.054	0.227	0.039	0.044	0.039	0.027	0.048

TABLE 8. Water consumptive use (m^3/fad) as affected by tillage systems and fertilization regimes .

Fertilization treatments	Tillage systems		
	CT	RT	NT
B_1	1452.40	401.54	1392.58
B_2	1550.57	1538.70	1501.30
B_3	1579.23	1551.48	1517.23
Mean	1527.40	1497.24	1470.37
F_1	1479.31	1469.21	1410.31
F_2	1502.64	1478.11	1425.43
F_3	1548.53	1541.50	1492.56
Mean	1510.16	1496.27	1442.77

Water use efficiency (WUE)

Data illustrated in Fig. 1 indicate the values of water use efficiency as affected by tillage systems and fertilization regimes. Water use efficiency values were influenced by tillage practices as well as fertilization treatments. The highest WUE value was obtained under conventional tillage. Water use efficiency values obtained under no-tillage system was lower than those obtained under conventional and reduced tillage systems. Concerning the fertilization treatments effect on the values of (WUE), the highest WUE values was found with biofertilization treatments compared to mineral and mineral organic treatments applied under all tillage treatments. The data also showed that (WUE) increased with increasing the applied biofertilizer rate. The highest (WUE) was found with B_3 followed by B_2 and B_1, respectively. The increase in (WUE) under mineral and organic fertilizers follow the order of $F_3 > F_2 > F_1$. These may be resulted from increasing the grain yield of wheat and decreasing the water consumptive use as the results of improving the soil physical properties consequently a good roots distribution under conventional tillage and the higher rates of biofertilizer compared to others treatments.

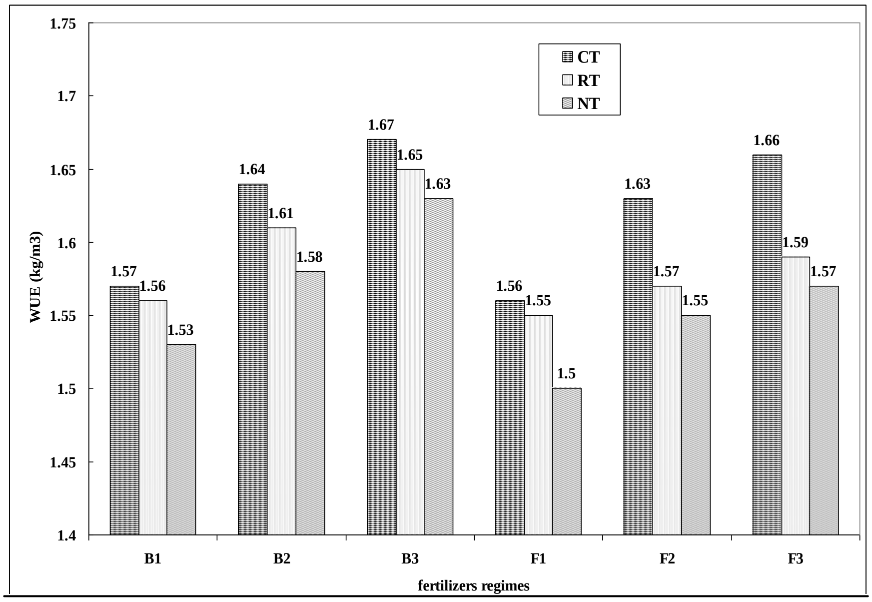

Fig.1. Water use efficiencies under different tillage systems and fertilizer regimes.

Conclusions

The results of the experiments concluded that:

1. Conventional (CT) and reduced (RT) tillage systems increased grain yield and its components compared to no-tillage system (NT). On the other hand, the increase in studied traits of wheat crop under CT was due to the enhancement in soil physical properties. The CT treatment has the lowest bulk density and the highest total porosity and hydraulic conductivity. While, the NT treatments has the highest bulk density and the lowest total porosity and hydraulic conductivity.
2. Inoculating wheat grains with biofertilizer (cerialine) increased plant height, grain yield and its attributes at higher rate (750 gm/fad) compared to mineral and mineral and organic fertilization treatments.
3. The highest water use efficiency was obtained under conventional tillage followed by reduced and no tillage systems, respectively. Meanwhile, increasing biofertilizer rate increased water use efficiency. Also, the combined treatment of mineral and organic fertilizers (F_3) increased water use efficiency.

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تأثير نظم مختلفة من الخدمة والتسميد على محصول القمح ومكوناته وعلى كفاءة استخدام المياة

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أجريت تجربة حقلية في محطة البحوث الزراعية التابعة لكلية الزراعة – جامعة القاهرة خلال الموسم الزراعي 2013/2012 لمقارنة تأثير ثلاث نظم للتسميد وهم التسميد الحيوي (تلقيح حبوب القمح بالسريالين بمعدلات 250 (B1) و 500 (B2) و750(B3) جرام/فدان ، التسميد المعدني NP والتسميد المعدني والعضوي معاً بنسب مختلفة 100 % NP (F1) و 75 % NP + 50 % كومبوست (F2) و 75 % NP + 75 % كومبوست (F3) من الجرعات الموصي بها تحت ثلاث نظم خدمة ميكانيكية للتربة ، خدمة عادية (CT) ، خدمة منخفضة (RT) و بدون خدمة (NT) علي بعض الخواص التربة الطبيعية وعلي محصول القمح وبعض مكوناته وكفاءة استخدام الماء بواسطة نبات القمح (صنف سخا 93) .

وقد أوضحت النتائج أن معاملة الخدمة العادية (CT) أظهرت زيادة معنوية في كل الصفات المدروسة للقمح مثل ارتفاع النبات وطول السنبلة وعدد الحبوب ووزن الـ 1000 حبة ومحصول الحبوب ومكوناتة يلية نظام الخدمة المخفض (RT) ثم نظام عدم الخدمة (NT) وكانت الفروق معنوية بين CT و NT و غير معنوية بين CT و RT .أوضحت النتائج ايضا انه تحت كل نظم الخدمة المختلفة فان هناك تأثيرات معنوية لمعاملات التسميد على ارتفاع النبات ومحصول الحبوب والقش ومكوناتة . حيث أوضحت النتائج ان تلقيح حبوب القمح بالسريالين بمعدل 750 جم/فدان أعطى أعلى زيادة لمحصول الحبوب والقش وجميع الصفات المدروسة كما انه قلل من الفروق بين محصول الحبوب ومحصول القش .

بالنسبة للتداخل بين نظم التسميد المعدنى والعضوى فقد وجد ان أعلى محصول القمح ومكوناته تم الحصول علية من (المعاملة 75% نيتروجين وفسفور+ 75% كمبوست) أى المعاملة (F3) . تأثرت ايضا قيم كفاءة استخدام المياه بنظم الخدمة والتسميد حيث وجد ان أعلى قيمة تم الحصول عليها من نظم الخدمة العادية ومعدل الاضافة 750 جم/فدان سريالين بينما أقل قيمة تم الحصول عليها من نظام عدم الخدمة مع اضافة التسميد المعدنى فقط. يتضح من النتائج انة يمكن استنتاج أن تلقيح حبوب القمح بالسريالين (سماد حيوي) بمعدل 750 جم/فدان مع (المعاملة 75% نيتروجين وفسفور+ 75% كمبوست) تحت نظم عملية الخدمة المختلفة للتربة يعطى أفضل النتائج وهذان النوعان من التسميد يخفضان الفرق بين محصول الحبوب والقش بين نظام الخدمة العادية ونظامى الخدمة المخفضة وعدم الخدمة ومن ثم يمكن تطبيق هذان النظامين – الخدمة المنخفضة وعدم الخدمة - مع الاخذ بالاعتبار التسميد الجيد للحصول على انتاجية مرتفعة من محصول القمح .