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The Effect of Some Nitrogen Fertilization Practices and Tillage Systems on Growth and Yield of Wheat Crop within The Conditions of The Sedimentary Plain in Iraq

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Abstract. This study was carried out in the Faculty of Agriculture in Abu Ghraib in silty loam texture soil classified as Typic Torrfluvents, as a factorial experiment in split-split plot designs with four replicates. Tillage treatment input in the main blocks, By dividing the field into three sections, the first was left without a tillage (T0), the second was plowed a surface plowing to a depth of 12 cm (T1), while the last section of the field plowed with moldboard plow was used at operating depth of 25 cm (T2). The Nitrogen fertilization was added as the following: Ground addition (N1) included the addition of 125 Kg N ha⁻¹ in two batches were added, first at the second irrigation after germination the wheat crop Ibaa 99 variety (broadcasting) and the second batch at the stage of expulsion of spikes, while the second treatment (N2) was foliar applied on the plant with the same amount above, as well as the third treatment (untreated control) no-Nitrogen fertilizer added (N0). At the end of the experiment after harvesting the following characteristics were studied: plant length, number of strokes, vegetative system weight, grain yield, weight of 1000 grains. Soil bulk density and the Mean weighted diameter of soil aggregate's for depths of 5-0, 10-5, 20-10, 30-20, and 30-40cm, and we measured the mean weighted diameter and volumetric distribution of soil aggregates by dry sieving method, also the water infiltration. The results showed that the tillage method had significant effect on the soil bulk density values of the soil after preparing the land for cultivation. Also, there were significant differences between tillage treatments in this property values after harvesting. While there was a significant effect of nitrogen fertilization in increasing the soil mean weighted diameter values as affected by tillage when compared with the control treatment (without nitrogen addition), the Nitrogen fertilization resulted a significant increase in the studied wheat crop growth indicators in both tillage treatments T1 and T2. Within two the Nitrogen addition methods N1 and N2 compared to the control treatment for both treatments. In addition, there was a significant effect for interaction for the two studied treatments on the overlap of both factors in the studied growth indicators. Also Nitrogen fertilization had a significant effect on wheat yield content (seed yield, 1000 grain weight and protein content in grains) due to reduce tillage and nitrogen fertilization was reflected in the increase of yield.

1. Introduction

Wheat is one of the most important strategic crops. Iraq's need in 2020 (6.45 million tons for wheat to meet the needs of the people), while the annual production of wheat in Iraq was covers only 35% [1], this means we necessary need to raise the production of this crop to cover Human requirements. The growing need at a minimum through horizontal expansion increasing the cultivated areas, or vertical expansion by raising the level of productivity of the unit of the land. The agricultural reality indicates the possibility of increasing horizontal



expansion due to limited space available for agricultural projects due to insufficient irrigation projects. The objective of the programs of development and scientific research is that the position of Iraq in terms of the productivity of wheat crop is at the end of the list of producing countries, as the rate of productivity for the whole of Iraq between 1.0-1.6 tonh⁻¹ while the production rate of wheat exceeded 3.2 tonh⁻¹ In Belgium and the Netherlands [2].

The optimal use and efficient management of soil and water are prerequisites for sustainability of agricultural production and the preservation of soil resource from degradation, as soil management through tillage or fertilization, irrigation and crop succession have a significant impact on growth and crop production [3]. It is known to plow as an administrative doctrine in Iraq that agriculture is done in most of its soil beyond the traditional procedure of tillage, which includes the use of the plow and tillage perpendicular to the orthogonal with indications to the need to adopt methods of plowing more appropriate to the soil, including plowing Reduced Tillage(RT), which was first adopted by the researcher [4], which is carried out through spike-teeth harrow and some machines that do not excite the soil significantly, which aims primarily to protect the soil from erosion, whether water or wind and it also preserves the remains of the previous crop in the soil. [5] Have shown that tillage has a direct impact on soil construction through mechanical fracturing of soil mass and large soil clusters and at the same time the surface of the converted soil is exposed to climate factors in particular water and air erosion.

Nitrogen is an essential nutrient for plants, and it is classified as one of the major nutrients that the plant needs in large quantities. In the event that it is not available at the required level, it limits the growth of the plant and weakens its performance, as well as it is considered a determining factor for the plant's ability to benefit from phosphorus and potassium in the soil. This is because it controls the biological processes inside the plant, and nitrogen is the only fertilizer element that is added to all crops and in all types of lands, as the plant absorbs nitrogen either in the form of NO₃ nitrate or NH₄ ammonium.

Al-Nedawi [6] Noted that the use of plows with different plowing depth had a significant effect in reducing the values of soil bulk density compared to a treatment without tillage, while [7] indicated that tillage deterioration the soil physical properties as a result of compacting at specific depths and crushing the soil and fragmenting it as a result of the passage of agricultural machinery and machines in the field, as well as conducting repeated tillage at the same depth and at inappropriate moisture levels.

Cassel [8] indicated a positive significant effect of tillage in increasing the stability of soil aggregates as a result of flipping and mixing crop residues and weeds in the soil. As for the negative effects, it was attributed to the direct effect of tillage in destroying soil aggregates due to their crushing and compacting when irregular passage of agricultural machinery during the tilling or indirect impact by accelerating and oxidizing the organic matter when mixing it in the soil, which reduces its positive effect on the aggregation of soil group units in the long term [9].

In terms of the effect of tillage on saturated water conductivity of the soil, [10] indicated that the effect of tillage on soil bulk density is reflected in the values of saturated water conductivity by increasing the proportion of large pores.

In a study carried out by [11] to compare the effect of tillage to a depth of 35 cm with surface tillage (by harrow) to a depth of 12 cm and their interaction with nitrogen fertilization in the characteristics of marsh soils and the production of rice and maize crops, the results showed that deep tillage led to a high significant decline In the values of soil bulk density and high significant increase in the soil mean weighted diameter and saturated water conductivity compared to surface tillage, and nitrogen fertilization did not effect on the studied soil characteristics except for the soil mean weighted diameter which increased significantly with the added nitrogen level, and deep tillage and nitrogen fertilization and their interaction resulted a high significant increase in the growth and productivity of rice and maize crops.

Hassan[12] explained when studying the effect of different soil tillage systems on the soil physical properties within the lands exploited for rain cultivation in the Nineveh Governorate

in clayey soils, that the best method of tillage is the use of a surface plow, then disc, and finally untilled, and the reason is due to the presence the hard pan in their study area.

Feng[13] Studied the effect of four tillage practices and five N rates on maize and wheat yield in North China. The results showed that the year-round total yield of wheat and maize under harrow tillage (HT) and rotary tillage (RT) was not significantly different from that of conventional tillage (CT, moldboard tillage) but was higher than that of no-tillage (NT). Reduced tillage (HT and RT) with straw returned and rate of nitrogen (157.5 Kg ha^{-1} for wheat and 202.5 Kg ha^{-1} N for maize) were suitable to increase the yield and adjust the soil carbon and nitrogen situation for the winter wheat-summer maize cropping system.

Alam[14] Studied the effects of medium-term tillage practices on soil properties and crop yields in Grey Terrace soil of Bangladesh under wheat-mungbean cropping system. Four different tillage practices, namely, zero tillage (ZT), minimum tillage (MT), conventional tillage (CT), and deep tillage (DT). Bulk and particle densities were decreased due to tillage practices, having the highest reduction of these properties and the highest increase of porosity and field capacity in zero tillage. The infiltration rate was found to be increased after every cropping cycle. All tillage practices showed similar yield after four years of cropping cycles.

Dorneles[15] Assessed the changes in soil chemical properties over a period of ten years, soil samples of a Paleudult were collected over nine seasons at three layer depths (0-5, 5-10, 10-20 cm) and were chemically analyzed. Three soil tillage systems were evaluated, conventional (CT), reduced (RT) and no-tillage (NT), combined with mineral (lime and fertilizers) and organic (poultry litter) fertilization. Phosphorus content was higher under organic than mineral fertilization due to the criteria used for the establishment of fertilizer doses. Soybean yield was lower under NT in comparison to the RT and CT systems. Consequently, soybean grain exported a lower content of nutrients than maize grain. Maize yield was not affected by either tillage or fertilization systems. Muhawish[16], when studying the effect of minimum tillage and conventional tillage in Gypsiferous soils in Salah Al-Din Governorate-Iraq, on the growth and productivity of wheat. The presence of clear and significant superiority of minimum tillage in the yield indicators (number of spikes per square meter, number of grains per spike, weight of one thousand grains, and grain yield), with proportions of superiority 34, 30.7, 44.7, 22.5 and 127.4% respectively. Nassir [17] observed a significant and negative effect of frequency plowing to depth 20 ± 5 cm by using the moldboard plow in soil bulk density and soil mean weight diameter at 15.2 and 3.61%, respectively.

Cook [18] Studied the effect of Four tillage (moldboard plow, chisel tillage, alternate tillage, and no-till) and five fertilizer treatments (no fertilization, N-only, N+NPK starter, NPK+NPK starter, and NPK broadcast) on corn yield in poorly drained soils, the results showed fertilizer management predominantly influenced crop yield and with complete NPK management non-tilled yields were similar to tilled. No-till with NPK management therefore may allow farmers to maintain high yields while reducing soil and nutrient losses in this soil condition.

The aim of this study is to investigate the effect of fertilization method and tillage system on the growth and yield of wheat crop under the conditions of the central region of Iraq.

2. Materials and Methods

2.1. Field site description.

This experiment was conducted in a field in the College of Agriculture-University of Baghdad-Abu Ghraib in the west of Bagdad province ($33^{\circ}17'31''\text{N}$ $44^{\circ}03'56''\text{E}$). The monthly average temperature and total precipitation in the study region for period 2014–2019 are presented in Table 1. The region soils classified Typic Torrifluents within MW5 series (Gassan) according to Al-Agadi's proposal for the series classification for sedimentary soils in Iraq [19], under the order Entisols in the USDA Soil Taxonomy, and the Tables 2 and 3 illustrated some of the soil physical, chemical and fertility (NPK) characteristics of the representative Pedon to study region, according to the methods described in [20]. The weeds in the field were controlled pre-experimented with a general herbicide Paraquat.

Table 1. Monthly mean temperature and total precipitation in study region during 2014–2019.

The month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Whole month
Mean Temp. (°C)	10.8	12.5	18.8	23.6	29.5	33.3	35.7	36.2	31.1	24.6	15.9	13.2	23.8
Max. Temp. (°C)	16.3	20.1	25.4	31.7	37.8	41.5	43.7	44.9	39.7	32.5	23.1	19.7	31.4
Min. Temp. (°C)	6.4	5.3	11.4	15.5	21.3	24.0	27.1	27.3	22.4	17.3	8.7	7.6	16.2
Rainfall (mm)	17.3	25.7	15.6	15.8	15.3	4.1	0.0	0.0	0.0	0.1	4.3	19.1	117.3

Table 2. some soil physical and chemical characteristics of the Pedon horizons which representative the field.

Horizon	Depth (m)	Practical size distribution of soil separators gmKg ⁻¹			Soil Texture class	Bulk density Mg ^m m ⁻³	Mean weight diameter (mm)	Organic matter	Soil content of carbonate	Soil content of gypsum	ECe dSm ⁻¹	pH
		Sand	Silt	Clay								
Ap	0-0.22	200	550	250	Sil	1.30	2.10	12	225	7	2.8	7.7
C1	0.22-0.45	230	520	250	Sil	1.35	1.95	6	256	11	2.5	7.8
C2	0.45-0.90	150	750	100	Sil	1.41	1.90	2	253	12	1.8	7.9
C3	0.90-1.10	120	760	120	Sil	1.60	1.62	Nil	256	20	1.9	8.0

Table 3. some of soil fertility characteristics of pedon horizons which representative field.

Horizon	Depth (m)	Available Nitrogen mgKg ⁻¹	Total Nitrogen %	Available Phosphorus mg.Kg ⁻¹	Available Potassium mgKg ⁻¹
Ap	0-0.22	6.8	0.23	5.1	256
C1	0.22-0.45	5.0	0.12	4.2	190
C2	0.45-0.90	1.7	0.09	3.0	171
C3	0.90-1.10	0.9	0.01	3.3	113

2.2. Experimental procedure.

The study was carried out as factorial experiment within split plot design with four replications, using the tillage treatment as the main plot by dividing the field into three sections, with a distance of 2 m, as the experimental unit area reached 25 m² inside each sector. The first section of the field was left without a tillage (T0) (a single slot is opened for seed sowing), the second section plowed a surface tillage of a depth of 12 cm using the Spike-teeth Harrow (T1), while the last section was plowed by a regular tillage of 25 cm depth using a moldboard plow (T2), and N fertilization methods as the subplot.

After completing the land preparation process for the cultivation, the soil bulk density was measured for depths 0-5, 5-10, 10-20, 20-30 and 30-40cm at each tillage treatment. with the calculation of the percentage of aggregates sizes for top soil (0-25 cm) before planting using the method which contented in the book of field and laboratory investigations in soil mechanics [21], (Table 4).

Table 4. Dry sieving results for surface soil before planting for tillage treatments

Tillage treatment	The percentage of grain sizes (mm)			
	Greater than 9.00	Less than 9.00	Less than 4.75	Less than 2.00
T0	72.1	27.6	14.5	13.1
T1	60.5	39.5	24.6	14.9
T2	50.4	49.6	33.9	15.7

Super phosphate fertilizer was added to all units at a rate of 57.6 KgP₂O₅ ha⁻¹, using a triple super phosphate 40% (P₂O₅) in one batch before planting (according to the recommendations of the Ministry of Agriculture in Iraq).

As for Nitrogen fertilization, it was as follows: ground addition (N1) included adding 125 Kg N ha⁻¹ in two equal batches, the first was added at the second irrigation after germination (broadcasting) and the second batch at the expulsion stage, using the Urea (46% N) as a source of this element (according to the recommendations of the Ministry of Agriculture in Iraq). The second treatment of Nitrogen (N2) included spraying the plant with the same amount (125 Kg N ha⁻¹), this amount was divided into six batches added to the plants from the stage of germination to the last sprinkling when the spike was completed at (20.85 Kg N ha⁻¹ for each spray), as well as the third treatment not-fertilized with Nitrogen (N0) (control treatment).

On 8/11/2019, Wheat (*Triticum estivum* L.) variety Iba'a 99, was planted with a seedling quantity of 80 Kg/ha, in the end of the experiment period 20/5/2020, Ten plants were randomly selected from the mean lines of the experimental units and studied the following characteristics: plant length, number of brushes, dry weight of the shoot system, after which the experimental units were harvested the grain yield was estimated, and weight of 1000 grains calculated, as well as the percentage of protein in the grains measured (By an Australian Crop Scan LB 2000 device in Ministry of Science and Technology). After harvesting the crop the soil bulk density and soil mean weighted diameter for depths 0-5, 5-10, 10-20, 20-30 and 30-40 cm at each treatment unit was estimated using the core and wet sieving methods for both parameters respectively, according to the methods mentioned in [20].

The double ring infiltrometer method was used to determine the water infiltration and was computed as cumulative infiltration and rate of infiltration in cm hr⁻¹, then the basic infiltration rate classified according to SOLR classification [22], Table 5.

2.3. Statistical analyses.

The data were statistically analyzed using the SPSS 17.0 Statistical Analysis System (Chicago, USA). The differences between the means of the crop yield and soil properties were determined using the least significance difference (LSD).

Table 5. SOLR classification for basic infiltration rate

Class symbol	Basic infiltration rate (cmhr-1)	Infiltration rate class
1	Less than 0.1	Very slow
2	0.1 – 0.5	Slow
3	0.5 – 2.0	Moderately slow
4	2.0 – 6.25	Moderate
5	6.25 – 12.75	Moderately rapid
6	12.75 – 24.50	Rapid
7	More than 24.50	Very rapid

3. Results and Discussion

3.1. Some physical and chemical characteristics of the field soil.

Table 2 shows some physical and chemical characteristics of the field soil, all the horizons soils were silty loam texture class, the soil content of clay ranged between 10-25%, silt

between 52-76% and sand between 12-23%, The high soil content of clay and silt separators was accompanied by an increase in the soil bulk density values, Its ranged between 1.30-1.60 Meg.m-3 the lowest value for this physical characteristic was recorded at the Ap horizon, due to the high soil content of organic matter at this horizon compared to other horizons, which reached 1.2% (Table, 3), as well as the high content of other horizons from calcium carbonate, which ranged between 22.5-25.6%, which raising the values of soil bulk density [3].

It is observed from the results of Table 3 that the tillage methods has a clear effect on the proportions of the volumetric distribution of soil aggregates, There was an increase in the proportions of the aggregates greater than 9.00 mm at the tillage treatments T0 and T1 by 39.5% and 7.2% compared to the treatment of tillage treatment T2, which indicates for repeated tillage and the increase in the entrance of the tractor and agricultural equipment to the field has a negative effect on the soil characteristics, as the tillage has caused an increase in the proportions of soil aggregates below 4.75 and 2.00 mm by 133.8% and 19.8% compared to the non-tillage treatment T0. These results were consistent with Al Bayati [7].

3.2. The soil bulk density

Results of Table 6, shows that the tillage method had an effect on the soil bulk density values after preparing the soil for cultivation, as the mean weighted for this parameter increased by 3.0% and 3.8% for the tillage treatments T1 and T2 respectively compared to treatment (T0), with a tendency to increase soil density values with depth at both tillage treatments comparison to control treatment (No tillage). While there was a decrease in the values of this indicator at the depth from 0-10 cm for the treatment of T1 and the depth 0-20 cm for the treatment of T2, this is due to the role of plowing in soil dismantling and mixing the organic matter with the topsoil. [7].

Table 6. The effect of tillage treatments in soil bulk density after preparing the land for cultivation.

Soil depth (cm) Tillage treatment	Soil bulk density (Meg. m-3)					Mean weighted (mm)
	0 -5	5 - 10	10 -20	20 – 30	30 - 40	
T0	1.25	1.30	1.35	1.35	1.36	1.33
T1	1.16	1.24	1.39	1.43	1.44	1.37
T2	1.15	1.25	1.32	1.45	1.50	1.38

Results of Table 7 showed that there are significant differences between tillage treatments from their effect on the values of the soil bulk density after harvesting, the highest value was recorded as average for the of regular tillage treatment (T2) was 1.47 Meg.m-3 compared to the tillage treatment (T0) which showed the lowest value for this soil physical character reached 1.35Meg.m-3, The increasing percentage for the tillage treatments T2 and T1 compared to T1 was 8.9% and 7.4% respectively, due to the mixing of the surface layer which have low bulk density with the sub-surface layer which have a high soil bulk density, in addition to the effect of tillage in increasing the oxidation and decomposition of the organic matter, which causes an increase in the soil bulk density of the surface layer compared to the No-tillage land, and this is consistent with what was observed by [7];[11].

As for the effect of the nitrogen fertilization method on the soil bulk density values, it is evident from the results of Table 7 that there is a significant effect of the fertilization method in reducing the soil bulk density values, the lowest mean 1.36 Meg.m-3 was recorded at treatment N1, while the highest mean value 1.46 Meg.m-3 was recorded at control treatment (T0). The relative effect of fertilizing with the nitrogen component in decreasing the values of the soil bulk density was more evident in the upper layers of the soil and in all treatments due to the effect of nitrogen in increasing the growth and spread of roots of the plant as well as reducing the ratio of N:C, which helped increase the activity of microorganisms and their ability to decompose the organic matter that contributed to improving soil structure and reducing its bulk density [23].

Table 7. The effect of tillage treatments and the method of Nitrogen fertilizer adding on the soil bulk density after harvesting.

Nitrogen fertilization practices	Soil depth (cm)	Soil bulk density (Meg.m-3)					Mean of fertilization practices
		0-5	5-10	10-20	20-30	30-40	
	Tillage Method						
N0	T0	1.30	1.35	1.40	1.42	1.43	1.46b
	T1	1.35	1.39	1.55	1.58	1.58	
	T2	1.37	1.45	1.55	1.59	1.58	
N1	T0	1.25	1.24	1.27	1.31	1.36	1.36a
	T1	1.28	1.30	1.40	1.42	1.51	
	T2	1.31	1.35	1.41	1.43	1.52	
N2	T0	1.31	1.34	1.39	1.40	1.42	1.45c
	T1	1.34	1.38	1.54	1.56	1.57	
	T2	1.37	1.45	1.55	1.58	1.58	
Mean of tillage methods	T0	1.29	1.31	1.35	1.38	1.40	1.35a
	T1	1.32	1.36	1.50	1.52	1.55	1.45b
	T2	1.35	1.42	1.50	1.53	1.56	1.47c
L.S.D0.05 for tillage T				0.010			
L.S.D0.05 for fertilization practices N				0.008			
L.S.D0.05 for the interaction T*N				0.105			

A mean followed by the different letters in line indicate significant at $\alpha \leq 0.05$

As for the effect of the interaction between the two factors of study on the soil bulk density ,it's also have a positive effect as the lowest value 1.29 Meg.m-3 was recorded at treatment T0xN1, while the highest value 1.59 Meg.m-3 of this indicator was recorded at treatment T2xN0, which indicates to the positive role of each tillage process and the nitrogen fertilizer in reducing the values of this physical characteristic.

3.3. Aggregate size distribution.

Table 8 showed there is a significant effect of tillage method on the mean weighted diameter values, as treatment T2 showed the lowest rate for this parameter reached 2.01 mm compared to the No-tillage treatment(T0), which showed the highest average was 2.24mm, This is due to the impact and intensity of tillage on the breaking down of the soil structure units [7].

Kadhim[24] have observed that the increase in the intensity of tillage has negatively a significant effect in decreasing the mean weighted diameter and porosity values by 2.39 and % 1.76 respectively, in a silty clay loam soil for one fields of the College of Agriculture-University of Baghdad (Abu Ghraib)-Iraq. From the results of Table 8 we observed, there is a significant effect of nitrogen fertilization in increasing the mean weighted diameter values of the soil which affected by tillage when compared to the control treatment (without adding nitrogen), due to the role of nitrogen fertilization in increasing the spread of the root system of plants, as well as increasing the effectiveness of microorganisms as a result of the presence of organic matter, with what observed by [11];[23].

Also the interaction between both study factors the tillage and fertilization showed a significant effect on soil mean weight diameter after harvesting (Table, 8). The treatment T0xN1 showed the highest value for this parameter for soil depth 0- 40cm was 2.79 mm, compared to treatments T2xN0 and T2xN2 where the values of this parameter were 1.71 and 1.73 mm respectively.

Table 8. The effect of tillage methods and the nitrogen fertilizer adding methods of in the values of the mean weighted diameter of the soil after the harvesting.

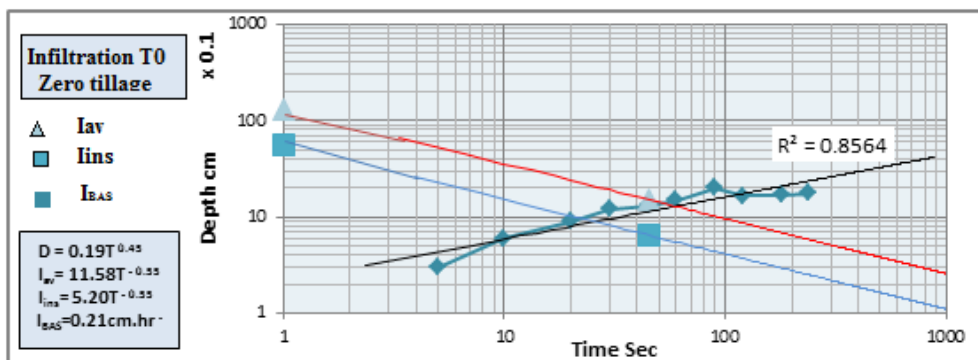
Nitrogen Fertilization practices	Depth (cm) Tillage Method	Mean weighted diameter (mm)					Mean of fertilization practices
		0-5	5-10	10-20	20-30	30-40	
N0	T0	2.10	2.02	1.95	1.93	1.91	1.83b
	T1	1.95	1.89	1.70	1.67	1.65	
	T2	1.90	1.80	1.68	1.64	1.63	
N1	T0	2.87	2.89	2.82	2.73	2.64	2.63a
	T1	2.80	2.75	2.55	2.52	2.37	
	T2	2.74	2.65	2.54	2.51	2.36	
N2	T0	2.04	1.99	1.92	1.91	1.88	1.80b
	T1	1.93	1.87	1.68	1.65	1.64	
	T2	1.88	1.77	1.66	1.63	1.61	
Mean of tillage methods	T0	2.34	2.30	2.23	2.19	2.14	2.24a
	T1	2.23	2.17	1.98	1.95	1.89	2.04b
	T2	2.21	2.07	1.96	1.93	1.87	2.01c
L.S.D0.05 for tillage T			0.052				
L.S.D0.05 for fertilization practices N			0.028				
L.S.D0.05 for the interaction T*N			0.095				

•A mean followed by the different letters in line indicate significant at $\alpha \leq$

which causes an increase in soil clusters, and this is consistent

3.4. Water infiltration rate.

The relationship between time and depth of infiltration water in the soil for the three tillage methods is being studied in the Fig. 1. Its ranged between 0.17-0.21cmhr-1 and according to SOLR basic infiltration rate classification(Tab. 5), all treatments infiltration test showed there are within moderately slow class. The heterogeneity recorded in the values of this hydrological characteristic is mainly due to the heterogeneity of the surface layer structure because of the tillage practices, which caused the difference in the quantity of water infiltrated in the soil. This result was consistent with what observed by Alam et al. [14] who was found the infiltration rate to be increased after every cropping cycle. After four years, the highest increase (18.44%) was found in ZT tillage treatment, followed by MT (7.35%) whereas CT and DT showed decreasing trend after two years.



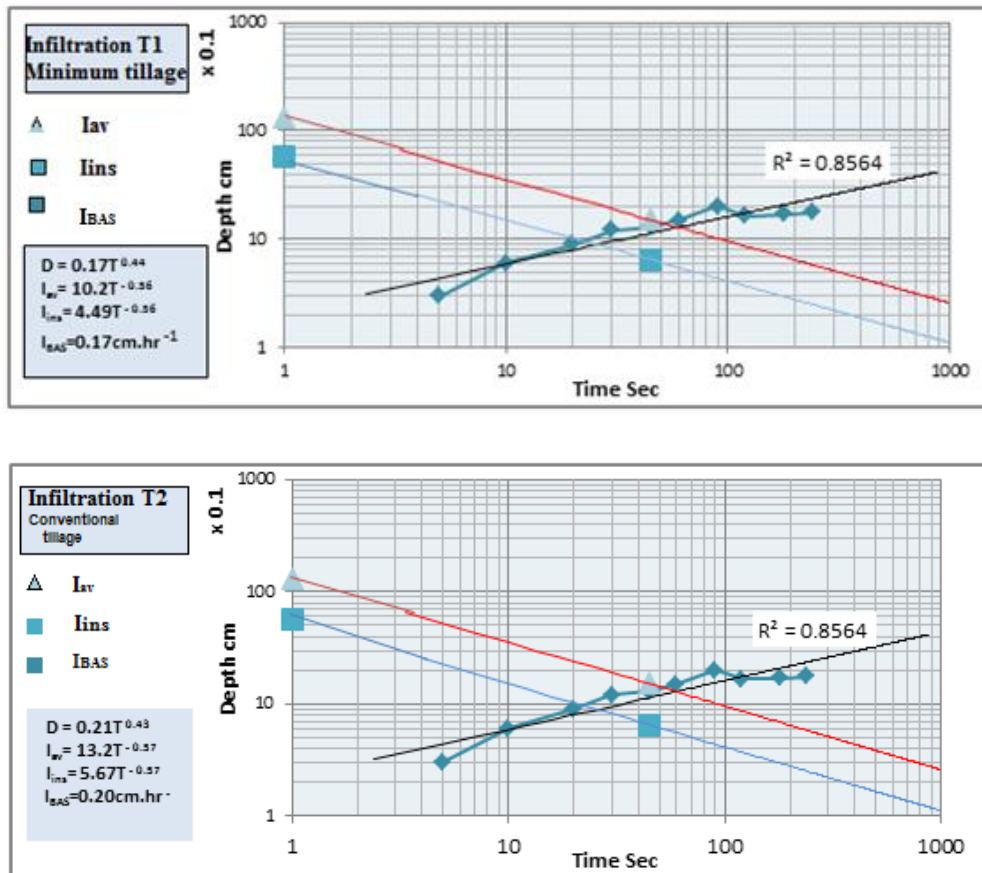


Figure 1. The logarithmic relationship between time and water depth for tillage treatments. As cumulative infiltration (cm) over cumulative time (sec).

3.5.Plant growth indicators.

It is evident from the results of Table 9 that nitrogen fertilization has led to a significant increase in the studied growth indicators of wheat crop in both the tillage treatments T1 and T2 and the two methods of adding the nitrogen element N1 and N2 compared to the control treatment for both study. It is evident from the results of Table 9 that nitrogen fertilization has led to a significant increase in the studied growth indicators of wheat crop in both the tillage treatments T1 and T2 and the two methods of adding the nitrogen element N1 and N2 compared to the control treatment for both study factors, as well as the interaction of both factors also showed a significant effect in the plant growth parameters, the highest plant length, number of tillers, and dry weight of the shoot system of plants were recorded in the N1xT1 treatment, due to the increased efficiency of nitrogen uptake as a result of improved soil physical properties and an increase in the size and extent of the root system of plants, these results was consistent with what observed by [11 and 23] who is obtained a better response to cereal plants (Rice and Maize) for nitrogen fertilization under conditions of deep tillage compared to surface tillage.

Table 9. The effect of the studied treatments on some wheat crop growth parameters.

Nitrogen fertilization practices	Biological index	Plant length (cm)	Mean of fertilization practices	Dry weight of the plant shoot system	Mean of fertilization practices	Number of tillers	Mean of fertilization practices
	Tillage method						
N0	T0	83.0		5.28		2.0	
	T1	83.2	81.9a	5.32	5.25a	2.2	1.97a
	T2	79.6		5.15		1.7	
N1	T0	100.7		7.23		2.4	
	T1	102.3	100.4e	7.34	7.29b	2.7	2.43a
	T2	98.1		7.29		2.2	
N2	T0	96.2		7.19		3.0	
	T1	98.5	96.8b	7.25	7.25b	3.3	3.03b
	T2	95.6		7.31		2.8	
Mean of tillage methods	T0		93.3		6.57		2.47ab
	T1		94.7		6.64		2.73b
	T2		91.1		6.58		2.23a
L.S.D0.05 for tillage T			N.S		N.S		0.432
L.S.D0.05 for fertilization practices N			6.590		0.617		0.510
L.S.D0.05 for the interaction T*N			10.321		0.903		0.825

•A mean followed by the different letters in line indicate significant at $\alpha \leq 0.05$

3.6. Grain yield indexes.

The effect of the two study treatments and their interaction in the grain yield, showed in Table 10 the fertilizing with the nitrogen element has a significant effect, In the components of wheat yield (seed yield, weight of 1000 grains, and the percentage of protein in seeds) a result of deep tillage and nitrogen fertilization has been reflected in the increasing the yield.

Table 10. The effect of the study treatments on the grain yield and some the yield Parameters.

Nitrogen fertilization practices	Yield index	Seed yield Kg h ⁻¹	Mean of fertilization practices	Weight of 1000 grains gm	Mean of fertilization practices	percentage of protein in seeds	Mean of fertilization method
	Tillage method						
N0	T0	860.0		42.1		11.1	
	T1	868.0	838.7a	48.4	43.3a	11.3	11.2a
	T2	788.0		39.4		11.2	
N1	T0	1047.6		44.3		14.4	
	T1	1070.5	1042.4c	49.4	45.5b	14.5	14.4b
	T2	1009.2		42.7		14.3	
N2	T0	1032.0		45.3		14.2	
	T1	1034.8	1022.4bc	47.4	45.1b	14.3	14.3b
	T2	1000.4		42.7		14.4	
Mean of tillage methods	T0		979.9ab		43.9b		13.2
	T1		991.1b		48.4c		13.4
	T2		932.7a		41.6a		13.3
L.S.D0.05 for tillage T			46.680		1.696		N.S
L.S.D0.05 for fertilization practices N			51.053		2.422		0.248
L.S.D0.05 for the interaction T*N			63.261		5.390		0.823

•A mean followed by the different letters in line indicate significant at $\alpha \leq 0.05$

It is possible from the results of this study to conclude that deep tillage did not give a significant effect in increasing the wheat crop growth parameters, as well as its productivity compared to surface tillage, and the surface tillage has helped to reduce the rates of soil bulk density and an increase in the soil mean weighted diameter rates at limitation of tillage. This improved the conditions of plant growth and greatly increased the productivity of the crop. Fertilization with nitrogen and its interaction with tillage were instrumental in improving the productivity of these soils.

4. Conclusions

The different tillage methods showed that they influenced soil physical and hydrological properties. T0 treatment, reduced the values of soil bulk density, and increased soil aggregate stability by increasing the mean weight diameter of aggregates. Also addition the Nitrogen fertilizers improved due to T0 and T1 practices. While there was a significant effect of Nitrogen fertilization in increasing the soil mean weighted diameter values as affected by tillage when compared with the control treatment (without Nitrogen addition), the Nitrogen fertilization resulted a significant increase in the studied wheat crop growth indicators in both tillage treatments T1 and T2. due to reduce tillage and nitrogen fertilization was reflected in the increase of yield.

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