

Replacement Part of Mineral N Fertilizer by Organic Ones and its Effect on Wheat Plant under Water Regime Conditions

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Abstract: Two field experiments were conducted during two successive seasons to study the effect of soil moisture regime (M1, M2 and M3) 80%, 60% and 40% of water holding capacity (WHC), respectively on wheat plant (*Triticum aestivum* L.) cv. Giza 168. Two sources of organic fertilizer (chicken manure, CM and sunflower residue, SR) and three levels of inorganic N (20, 40 and 60 kg/fed) were applied. Data revealed that increasing or decreasing the water holding capacity at the root zone resulted in a significant decrease on yield of grain and straw. Application of irrigation at 60% WHC resulted in the highest yield in two seasons. The interaction between irrigation and fertilization significantly increased grain and straw yields as compared with the control. Adding N fertilizer at a rate 40 kg N/fed with CM and SR gave an increase in N and K uptake in soil water regime M1 and M2. Data also, indicated the high level of moisture (M1) with fertilizer gave high increase in P content and uptake as compared with M2 and M3. Application organic matter with nitrogen levels gave an increase in N, P and K uptake and/or content as compared with adding organic matter alone. Application of the studied materials (CM and SR) increased water use efficiency caused by improving water retained in soil. When wheat crop depending mainly on the organic N, WUE values increased by about 87, 67%; 39, 34% as compared with control one for grain and straw after using CM and SR materials, respectively. While increasing inorganic N till 60 kg/fed increased WUE by about 139, 125%; for grain and 86, 67% for straw after using CM and SR materials, respectively.

Key words: Organic residues • wheat • N fertilizer • NPK uptake • yield • water use efficiency.

INTRODUCTION

Wheat is one of most important cereal food crop in the world. In Egypt, its production doesn't meet the current demand so, Egyptian government does more efforts to reduce the import percentage lower than 50% from the total consumption. Wheat production is affected by different factors such as climatic condition, irrigation and soil fertility. The new reclaimed areas are continuously increasing and water for irrigation will become the limiting factor. Irrigation, fertilization and their interaction are considered the important factors for increasing yield production. Heggy *et al.* [1] pointed out that irrigation of wheat at long intervals decreased yield than the irrigation at short intervals. Elemery *et al.* [2] indicated that the increase in water supply decreased element of wheat grain. Sushila and Gajendra [3] indicated that application of farmyard manure (FYM) increased the growth, yield and water use efficiency of wheat under

limited of water supply. Also, for reducing irrigation water use, it is necessary to examine the possibility of further reducing irrigation applied by optimizing the irrigation scheduling [4]. Zhang *et al.* [5] stated that improvement in both grain and straw production was associated with many factors such as improved cultivars and production practices.

Stopper and Harris [6] found that early sowing of wheat has an advantage in terms of grain yield and WUE, particularly when practiced in conjunction with good N - supply and supplemental irrigation. Wheat production improvement from a limited water supply can be obtained by increasing the total amount of water used by the crop through supplemental irrigation and improving the efficiency of water usage through the adoption of deficit irrigation and early sowing [7].

Addition of N fertilizer tended to produce high yield, regardless of quantity or distribution of water [8]. Reddy and Shastry [9] attributed reduced uptake P and K under

restricted moisture supply to their reduced mobility at low moisture level. Parihar and Tiwari [10] found that N concentration decreased, while P and K content increased with the increase in number of irrigation.

The purpose of this study was to investigate the potential of inorganic N and a variety of locally available organic wastes, to assess the close correlations between organic and inorganic N supply for wheat plant by its need from N and optimize crops production.

MATERIALS AND METHODS

Two field experiments were conducted on wheat during two successive winter seasons (2004/2005, 2005/2006) in El - katta village, Giza governorate to study the effect of organic residues and nitrogen fertilizer on chemical composition and water use efficiency on wheat plant under different water regime.

The investigated soil is loamy sand in texture relative to its constituents (81.13% sand, 12.90% silt and 5.97% clay). Values of soil water constant were 27.36, 12.74 and 4.84% for water holding capacity, field capacity and wilting point, respectively. Soil pH (7.79) EC (0.36 dS m⁻¹), CaCO₃ (2.51%) and organic matter content (0.68%) were recorded. Soil exchangeable capacity was 7.11 meq/100 g soil and available macro nutrients N, P and K were 36, 14 and 66 ppm, respectively.

Two types of organic materials were used, chicken manure (CM) and composted of sunflower residues (SR). Application rate of two OM used depends on its content of N and the total required N (120 N kg/fed), which added by organic materials only and/or by complete the rest by N fertilizer as follows:

- Control (with recommended doses)
- Organic materials applied (CM or SR)
- 100 kg organic N + 20 kg inorganic N/fed
- 80 kg organic N + 40 kg inorganic N/fed
- 60 kg organic N + 60 kg inorganic N/fed was take place

From the above mentioned treatments that increasing N fertilizer associated with decreasing in the amount of OM application.

The experimental design included two factors five treatments from quantity of N fertilizer applied and three soil moisture levels 80%, 60% and 40% of water holding capacity (WHC) M1, M2 and M3, respectively (equal 6, 4 and 3 irrigations during the growing seasons were applied from the beginning of second irrigation) in combination with two organic residues and three levels of nitrogen

fertilizer treatments with three replicates. So the experimental plots area is 10.5 m², half meter among. The design of each experiment was Complete Randomized Block System in three replicates.

The organic material (CM and SR) were thoroughly mixed with 0-30 cm of the surface soil layer before sowing. Some chemical properties of CH and SR such as pH 1:10 (7.40, 7.79), EC 1:10 (3.78, 3.16 dS m⁻¹), organic matter (58.60, 52.24%), organic carbon (34.07, 30.95%), total NPK % (3.35, 2.89; 0.63, 0.49; 0.41, 1.21), respectively were determined. Three level of nitrogen 20, 40 and 60 kg N/fed as ammonium sulfate were added three weeks after sowing.

Wheat seeds (*Triticum aestivum* L.) cv Giza 168 were sown on the last of November at rate 60 kg/fed for both seasons. Superphosphat (15.5% P₂O₅) and potassium sulphat (48% K₂O) were added at rate of 50 kg/fed, respectively. At the maturity stage, wheat plants were harvested and samples from grains and whole plants of each treatment were oven dried at 70° for analysis. Samples were digested with acid mixture. Nitrogen, phosphorus and potassium were determined according to the method described by Cottenie *et al.* [11].

Soil particle size analysis of virgin sandy soil under study was determined by pipette method after Majumdar and Singh [12]. Soil water content by weight at the field capacity and wilting point was measured on samples passing a 2 mm sieve, saturated for 24 h and then equilibrated for 24 h at 33 kPa and 1500 kPa on a tension table and pressure - plate apparatus, respectively. Available water was calculated from equation:

$$AW = FC - WP$$

Where; AW is available water (g water 100 g⁻¹ soil); FC is soil θ_w % at field capacity (g water/100 g soil); WP is soil θ_w % at wilting point (g water 100 g⁻¹ soil) according to Klute [13]. Data were statistically analyzed after Snedecor and Cochran [14].

RESULTS AND DISCUSSION

Effect of organic residue, nitrogen fertilizer and water regime on yield: Data in Table 1 shown that increasing or decreasing the water holding capacity 80% and 40% WHC (M1 and M3) at the root zone resulted in a significant decrease on yield of grain and straw. Application of irrigation at 60% WHC increased grain and straw yield of wheat. These results attributed the decline in yield by decreasing soil moisture content to a loss in turgidity and

Table 1: Yield of wheat grain and straw as affected by fertilization treatments and water regime (average two seasons)

N treatment									
WR		Grain tone/fed				Straw ton/fed			
CM	Fertilizer	M1	M2	M3	Mean	M1	M2	M3	Mean
Control (recommended doses)		1.076	1.164	0.487	0.909	2.244	2.613	0.952	1.936
120	0	2.182	2.029	0.912	1.708	3.070	3.614	1.337	2.674
100	20	2.503	2.893	1.147	2.181	3.940	4.551	1.607	3.366
80	40	2.931	3.211	1.251	2.464	4.807	5.099	1.816	3.907
60	60	2.609	2.971	1.011	2.197	4.111	4.866	1.796	3.591
Mean		2.260	2.454	0.962		3.634	4.149	1.502	
L.S.D. 5%		N treatment	WR %	Interaction		N treatment	WR %	Interaction	
		0.230	0.181	0.203		0.261	0.211	0.234	
SR	Fertilizer	M1	M2	M3	Mean	M1	M2	M3	Mean
Control (recommended doses)		1.076	1.164	0.487	0.909	2.244	2.613	0.952	1.936
120	0	2.014	1.919	0.700	1.544	3.136	3.473	1.199	2.603
100	20	2.337	2.533	0.816	1.895	3.238	4.011	1.466	2.905
80	40	2.600	3.085	1.149	2.278	4.227	4.697	1.650	3.525
60	60	2.477	2.695	1.000	2.057	3.846	4.044	1.740	3.210
Mean		2.101	2.279	0.830		3.338	3.768	1.401	
L.S.D. 5%		N treatment	WR %	Interaction		N treatment	WR %	Interaction	
		0.252	0.190	0.218		0.312	0.230	0.246	

WR: water regime, M1: 80%, M2: 60%, M3: 40% of water holding capacity, CM: Chicken manure, SR : Sunflower residue

disturbance of physiological process. Similar results were obtained by Yassen [15].

As far as interaction between irrigation and N treatment the data in Table 1 clearly showed that grain and straw yield increased significantly with different N treatment compared with control under both conditions of M1, M2 and M3. These increases in grain and straw yields may be attributed to the enhancement of vegetative growth and yield. These results are in a good agreement with those obtained by Sushila and Gajendra [3].

Table 1 showed that the effect of both organic mater used and N level on wheat grain and straw yield under different water regime (WR). Data on hand revealed that decreasing application rate, to decrease dependant organic N and accompanied with increasing N level led to increase in wheat grain and straw yield under different studied water regime conditions except at treatment 60 kg N/fed from both organic material used.

According to the different N level decreasing rate of CM and increasing N level increased wheat grain and straw yield by about 87.9, 139.9, 171.1 and 141.0% for grain and 38.1, 73.9, 101.8 and 85.5% for straw as

compared with control one. The same trend was observed after using SR material and the values were 69.9, 108.5, 50.6 and 126.3% for wheat grain yield and 34.5, 50.1, 82.1 and 65.8% for wheat straw yield as compared with the control treatment.

Regardless the effect of N levels, decreasing moisture content in root zone, water regime level, decreasing in grain wheat yield after using CM material were take place and values could be arranged in descending order as follows: M1 > M2 > M3, but in case of straw yield the trend was M2 > M1 > M3 in descending order.

In the case of using SR, decreasing water content in root zone decrease wheat yield of grain and straw except at M2. The wheat yield could be arranged in descending order as follows: M2 > M1 > M3 for both grain and straw yield. According to the OM type, data on hand revealed that grain and straw yield for CM is more pronounced effect than that of SR by about 8.9 and 9.1%, respectively. Regardless the effect of N level, water regime treatments have also a pronounced effect after CM application that after SR type except M2 in grain yield which gave higher yield(2.279 ton/fed). The maximum and minimum values of

Table 2: Effect of water regime and fertilizer treatments on N uptake (kg/fed) of wheat plants (average two seasons)

N treatment									
WR		Grain				Straw			
CM	Fertilizer	M1	M2	M3	Mean	M1	M2	M3	Mean
Control (recommended doses)		8.72	10.24	3.70	7.55	7.40	7.89	2.47	5.92
120	0	29.02	29.42	11.49	23.31	13.20	16.26	4.81	11.42
100	20	40.55	48.89	16.17	35.20	22.06	29.13	8.36	19.85
80	40	50.71	59.08	19.01	42.93	30.28	34.67	10.79	25.25
60	60	43.05	50.80	15.06	36.30	25.48	34.54	9.88	23.30
Mean		34.41	39.69	13.09		19.69	24.50	7.26	
L.S.D. 5%		N treatment	WR %	Interaction		N treatment	WR %	Interaction	
		6.24	3.45	4.52		7.12	3.87	5.12	
SR	Fertilizer	M1	M2	M3	Mean	M1	M2	M3	Mean
Control (recommended doses)		8.72	10.24	3.70	7.55	7.40	7.89	2.47	5.92
120	0	27.19	27.25	9.31	21.25	14.43	17.36	4.91	12.23
100	20	35.76	41.03	12.64	29.81	21.69	27.27	8.06	19.01
80	40	42.90	54.30	17.92	38.37	28.74	38.52	10.39	25.88
60	60	39.13	44.74	15.20	33.02	27.30	29.93	10.52	22.58
Mean		30.74	35.51	11.75		19.91	24.19	7.27	
L.S.D. 5%		N treatment	WR %	Interaction		N treatment	WR %	Interaction	
		6.36	3.57	4.38		6.87	4.01	5.26	

WR: water regime, M1: 80%, M2: 60%, M3: 40% of water holding capacity, CM: Chicken manure, SR : Sunflower residue

wheat grain and straw yield were 3.211, 0.087; 0.952, 5.99 ton/fed after CM application and 0.487, 3.085; 0.952, 4.697 ton/fed after using SR application, respectively. These results corroborate the finding of Camara *et al.* [8].

When wheat plant received all N requirement from OM, grain and straw yield increased by about 89, 70%; 38, 34% for CM and SR materials, respectively. While decreasing OM rate and increase N level up to 40 kg/fed increase the wheat yield by about 171, 151% for grain and 102, 82% for straw after using CM and SR materials, respectively.

From the obvious result it can be concluded that i) M2 was the best soil moisture save water by about 20% relative to M1 (WHC) and increase grain and straw yield by about 8 - 13% respectively. ii) inorganic at 40 kg N/fed has a pronounced effect on yield and increased grain and straw yield by about 146%; 84%.

Data of combination between WR treatments and OM types were recorded in Table 1. Data on hand revealed that WR2 (M2) in both materials used gave the highest wheat yield of grain and straw. But CM material gave an increasing by about 8 and 10% as compared with SR material, for grain and straw yield, respectively.

Effect of organic residues, nitrogen fertilizer and water regime on chemical composition: Data in Table 2 show that irrigation at M2 (60% of WHC) gave slight increase of nitrogen content and/or uptake in grain and straw followed by irrigation at 80% and 40% of water holding capacity. The decreasing of nutrients in wheat plant at 40% WHC (M3) may be due to redacting the solubility, decreasing the soil moisture content, of mineral in the soil films are thin and path length of movement increase; hence movement of cations to root is reduced. High tension exerts a physiological effect on the root, elongation, turgidity and number of root hairs decrease with increasing tension, the decrease nutrients uptake by water stress also has been supported by Nelson [16]. On the other hand, the decrease in the nutrients uptake at high WHC (M1) may be attributed to the decrease in aeration caused by filling all pores with water which increasing anaerobic respiration (conditions). Hence this phenomenon affects on root physiology functions in water and materials, consequently reduction in dry matter content is expected.

With respect to the effect of water regimes combined with fertilizers addition, data indicated that N - uptake and

Table 3: Effect of water regime and fertilizer treatments on P uptake (kg/fed) of wheat plants (average two seasons)

N treatment									
WR		Grain				Straw			
CM	Fertilizer	M1	M2	M3	Mean	M1	M2	M3	Mean
Control (recommended doses)		3.55	3.37	1.21	2.71	4.94	4.70	1.33	3.66
120	0	10.69	7.30	3.01	7.00	8.90	8.67	2.80	6.79
100	20	18.02	16.78	4.93	13.24	12.60	12.74	4.18	9.84
80	40	21.92	20.22	7.25	16.46	16.34	15.80	5.21	12.45
60	60	17.21	15.74	5.26	12.74	12.74	14.11	5.02	10.62
Mean		14.28	12.69	4.33		11.10	11.20	3.71	
L.S.D. 5%		N treatment	WR %	Interaction		N treatment	WR %	Interaction	
		2.56	1.23	1.76		0.16	0.07	0.09	
SR	Fertilizer	M1	M2	M3	Mean	M1	M2	M3	Mean
Control (recommended doses)		3.55	3.37	1.21	2.71	4.94	4.70	1.33	3.66
120	0	10.67	9.02	3.57		9.40	9.03	2.76	7.06
100	20	16.59	15.95	5.22		11.09	11.23	4.39	8.90
80	40	19.76	19.43	7.12		14.79	14.56	4.78	11.38
60	60	20.31	15.09	5.70		12.31	12.13	4.91	9.78
Mean		14.18	12.57	4.51		10.51	10.33	3.13	
L.S.D. 5%		N treatment	WR %	Interaction		N treatment	WR %	Interaction	
		2.75	1.23	1.87		0.27	0.12	0.18	

WR: water regime, M1: 80%, M2: 60%, M3: 40% of water holding capacity, CM: Chicken manure, SR : Sunflower resid

content in grain and straw increased sharply with N application as compared with the control. The increases in N uptake values were obtained with M2 as compared to M1 and M3. According to the effect of N - fertilizer treatment, increasing inorganic N increased N uptake in both grain and straw under the two organic materials used (CM and SR). It could arrange the mean values of the N fertilizer treatment in descending order as follows: 40 N > 20 N > 60 N > control. The same trend in case of effect of water regime on the N uptake Table 2.

These results indicated that organic and inorganic N increased the capacity of the wheat plant to absorbing nutrients. This might be through the increase in the root surface per unit of soil volume and the rate of nutrients uptake or may be cause by the high capacity of the plants supplied with N fertilizer in building metabolites, which might contribute much to the increase of the dry matter content [17].

Data also, revealed that N uptake and content of straw was much lower than those of grain for all treatments under study. It was noticed that application of organic matter with inorganic N levels gave an

increase in N uptake and content in grain and straw as compared to organic matter added alone in M1, M2 and M3. These results are agreed with Ravindra and Agarwal [18].

Phosphorus uptake was decreased by decreasing soil moisture level at M3 (40% WHC) compared with other soil moisture treatment (M1 and M2) in grains and straw of wheat plant. Regarding to the effect of water regimes combined with fertilizer treatments on P uptake and content in Table 3. It is obvious that high level of moisture (M1) with N fertilizer gave high increase in P uptake and content as compared with M2 and M3 in grains and straw. This may suggest that increasing soil moisture increased P uptake. Possibly the soluble nitrogen form is leached under the effect of sufficient water, particularly if CO₂ from the root respiration is increased, this may be an agent for solubilization of P salts. Furthermore, the effect of reduced soil moisture content included an increase in the solution concentration of non absorbed nutrients and that of exchangeable cations which tend to reduce the concentration of absorbed anions like phosphate [11, 12].

Table 4: Effect of water regime and fertilizer treatments on K uptake (kg/fed) of wheat plants (average two seasons)

N treatment									
WR		Grain				Straw			
CM	Fertilizer	M1	M2	M3	Mean	M1	M2	M3	Mean
Control (recommended doses)		5.38	6.75	2.04	4.72	51.16	55.39	19.99	42.18
120	0	12.02	12.99	5.02	10.01	97.32	125.77	36.63	86.57
100	20	16.02	21.70	5.28	14.33	154.45	193.42	45.63	131.17
80	40	19.34	25.37	6.00	16.90	220.64	243.32	79.27	181.08
60	60	15.13	21.09	5.26	13.83	168.55	212.64	71.48	150.89
Mean		13.58	17.58	4.72		138.42	166.11	50.60	
L.S.D. 5%		N treatment	WR %	Interaction		N treatment	WR %	Interaction	
		2.15	1.98	2.01		30.25	20.17	23.56	
SR	Fertilizer	M1	M2	M3	Mean	M1	M2	M3	Mean
Control (recommended doses)		5.38	6.75	2.04		51.16	55.39	19.99	
120	0	11.68	12.67	3.92		119.17	147.26	44.00	
100	20	15.98	20.26	5.79		145.06	180.90	65.97	
80	40	18.98	26.22	8.38		181.76	219.35	76.07	
60	60	16.84	20.75	7.00		173.84	193.30	80.33	
Mean		13.77	17.33	5.43		134.20	159.24	57.27	
L.S.D. 5%		N treatment	WR %	Interaction		N treatment	WR %	Interaction	
		5.12	3.12	4.21		28.30	21.45	26.11	

WR: water regime, M1: 80%, M2: 60%, M3: 40% of water holding capacity, CM: Chicken manure, SR : Sunflower residue

According to the effect of N - fertilizer treatment, increasing inorganic N increased P - uptake and content in both grain and straw yield under CM and SR organic materials (Table 3). Chicken manure and sunflower residue applied with N fertilization gave high values of P uptake and content compared with them added alone. M2 gave the highest P concentration and uptake with other treatment at all water regimes in grains and straw in chicken manure, whereas M3 treatment with sunflower residue gave higher increase in P content and uptake at M1.

According to the effect of N - fertilizer treatment, increase inorganic N increased K - uptake and content in both grain and straw under the CM and SR materials used. It could arrange the mean values of the N fertilizer treatment in descending order as follows: 40 N > 20 N > 60 N > control. The same trend was observed in case of effect of water regime on the K - uptake Table 4. Water regime treatment (M2) has a pronounced effect on the K - uptake in grain and straw.

Potassium uptake by grain and straw in Table 4 were clearly affected by organic residues type and

inorganic N levels under different water regime. Results showed the increase uptake by wheat plant compared with the control. The highest value was obtained when applied organic residue (CM or SR with inorganic N 40 kg/fed) in both water regime for grain and straw. Also, data revealed that K uptake in straw was greater than that in grain. These results agreed with Ravindra and Agarwal [18].

Also, an increase in inorganic N showed a positive correlations at 5% level with N uptake ($r = 0.468^*$; 0.486^*). However, water regime treatments negatively correlated with increasing inorganic N with significance at 5% level ($r = - 0.437^*$). On the other side, one can notice that OM could retain water more than the studied soil alone, so it plays an important role in to way, 1st provides plant root by its water requirements and 2nd some essentially plant nutrient would release to provide the grown plant by its requirements. This effect reflected on the studied parameters such yield, nutrient uptake and WUE. Also, increasing inorganic N showed a positive correlation significant at 5% level with N uptake.

Table 5: Water use efficiency for grain and straw yield as affected by fertilization treatments and water regime (average two seasons)

N treatment									
WR		Grain (kg m ⁻³)				Straw (kg m ⁻³)			
CM	Fertilizer	M1	M2	M3	Mean	M1	M2	M3	Mean
Control (recommended doses)		0.62	0.89	0.56	0.69	1.29	1.10	2.00	1.46
120	0	1.26	1.56	1.05	1.29	1.77	2.77	1.54	2.03
100	20	1.44	2.22	1.32	1.66	2.27	3.49	1.85	2.54
80	40	1.69	2.46	1.44	1.86	2.76	3.91	2.14	2.94
60	60	1.50	2.28	1.16	1.65	2.36	3.73	2.07	2.72
Mean		1.30	1.88	1.11		2.09	3.18	1.74	
L.S.D. 5%		N treatment	WR %	Interaction		N treatment	WR %	Interaction	
		0.24	0.19	0.21		0.28	0.21	0.24	
SR	Fertilizer	M1	M2	M3	Mean	M1	M2	M3	Mean
Control (recommended doses)		0.62	0.89	0.56	0.69	1.29	2.00	1.10	1.46
120	0	1.16	1.47	0.81	1.15	1.80	2.66	1.38	1.95
100	20	1.50	1.94	0.94	1.41	1.86	3.08	1.69	2.21
80	40	1.42	2.37	1.32	1.73	2.43	3.60	1.90	2.64
60	60	1.21	2.07	1.15	1.55	2.21	3.10	2.02	2.44
Mean		1.34	1.75	0.96		1.92	2.89	1.62	
L.S.D. 5%		N treatment	WR %	Interaction		N treatment	WR %	Interaction	
		0.28	0.16	0.19		0.40	0.31	0.37	

WR: water regime, M1: 80%, M2: 60%, M3: 40% of water holding capacity, CM: Chicken manure, SR: Sunflower residue

Effect of organic residues, nitrogen fertilizer and water regime on water use efficiency (WUE): Table 5 illustrates the effect of OM types and N treatment on the water use efficiency (WUE) of wheat grain and straw yield under three different water regime. Results showed that increase inorganic N levels and decrease organic N led to increase the values of WUE. There were significant differences at 5% level between WUE values under two organic residues used. The maximum and minimum of WUE values were 1.88; 1.11 and 1.75; 0.96 kg m⁻³ irrigation water used for grain and 3.18; 1.74 and 1.62 kg m⁻³ irrigation water used for straw, after using CM and SR materials in WR2 and WR3, respectively according to the water regime treatments. Values of WUE could be arranged in descending order as follows: M2 > M1 > M3 at the two OM used. The interactive effects of N treatment and WR treatments on WUE were illustrated in Table 5.

Data on hand revealed that the increasing inorganic N levels increased WUE of wheat grain and straw after CM and SR application except at inorganic N level 60 kg/fed. But results showed that CM material has more pronounced effect than SR material on increasing

WUE values. The same trend was observed in case of straw WUE values after using both studied materials. When wheat crop depending mainly on the organic N, WUE values increased by about 87, 67%; 39, 34% as compared with control one (received recommended doses) for grain and straw after using CM and SR materials, respectively. While increasing inorganic N till 60 kg/fed increased WUE by about 139, 125%; for grain and 86, 67% for straw after using CM and SR materials, respectively.

The effect of improvement in WUE values in both grain and straw may be attributed to the effect of organic materials used on soil ability to retain water which provide the grown plants by its requirements in the period between irrigation intervals. These results agreed with those obtained by Chandra *et al.* [19] who stated that WUE decreased with increasing irrigation frequency. Also, statistical analysis showed that there were highly positive significant correlation coefficients at 1% level between OM and WUE values ($r = 0.586^{**}$) which attributed to the positive effect of OM used in improve soil hydro - physical properties in low amount.

Finally, it could be concluded that partial replacement of inorganic N by organic ones increased all the studied parameters such as wheat yield, nutrient status in grain and straw in plant and WUE. Also, application of CM is more effective than SF in case of NPK uptake and content of wheat plant. From the other side CM and its status of plant nutrients was reflected on increasing both grain and straw yield. Hence, saving in nitrogen fertilizers, irrigation water and increasing wheat yield is expected under the same experimental conditions.

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