Introduction

Wheat is the most important cereal crop as staple food grain in Egypt, where the local production is not sufficient to supply the annual demand of the increasing population. This caused gap between production and consumption. Hence, increasing wheat production is the most important possibility for reducing the wheat gap and reach self-sufficiency of wheat production. To achieve the obvious aim, it could be realized by two ways: First: expanding the area sown, second: improving the yield per unit area sown. Wheat areas in sandy soils have gradually increased over the last few years, due to the limitation of agricultural land in the old valley. Sandy soils are very much considered in the plain of horizontal expansion in Egypt [1]. Such soils are characterized by their bulk density and low values of native nutrient content and the high leaching losses of applied fertilizers, and water irrigation.

To overcome the sandy soils problem, it requires great efforts to improve its hydro-physical properties, as well as its productivity. The application compost as organic matter to such soil is desperately needed [2]. To increase soil fertilizer and minimize nutrient loss due to leaching, as well as improve moistureholding capacity of sandy soil irrigation.

The current research is an attempt to find further ways to solve water scarcity in sandy soils in Egypt to increase water use efficiency for wheat, through optimizing water irrigation supply [3]. Recycling plants residues by converting them to compost that improves the physical, chemical and biological properties of sandy soils are needed. This may protect the new reclaimed land from the problems of pollution resulted from applying chemical fertilizers intensively for high production [4]. This investigation was carried out, to find out the effect of water irrigation quantity and organic fertilizer rates (compost) on growth, yield and yield components as well as water relationships for some wheat cultivars. Also, an important objective is finding out the best varieties which can be adapted under such desert environment conditions [5].

Materials and Methods

Two field experiments were carried out during two successive growing seasons of 2009/2010 and 2010/2011 at EL Busily area-Rosetta center, EL Behera governorate, Egypt to study the effect of irrigation quantity and compost rates on growth and yield of two wheat cultivars under the condition of fixed sprinkler irrigation system in sandy soil [6]. The varieties of wheat (Triticum aestivum) tested in this study were two high-yielding wheat cultivars; sakha93 and jemmieza9. Experimental field included eighteen treatments which were the combination of three levels of water irrigation quantity, three rates of compost fertilizer and two wheat varieties.

The agricultural treatments tested

A-Water irrigation quantity: 60, 70 and 90% from evapotranspiration rate.
B- Compost fertilizer rates: 2, 4 and 6 ton per Fadden.
C-Wheat varieties: 1- Sakha 93 2 - Gemmeiza 9

Keywords: Irrigation scheduling; Compost; Wheat; Quantity; Varieties
Soil samples were collected at experimental site to depth of 30,60 and 90 cm. before sowing for mechanical and chemical analysis which recorded in Tables 1 and 2 respectively. While Chemical analyses for compost fertilizer are given in Table 3. A split-split design with three replicates was used [7]. The main plots were randomly devoted to the irrigation quantity treatments. The sub plots were randomly devoted to the compost fertilizer rates. The sub-sub plots were randomly assigned to the two wheat varieties. Seeding rate was 60 kg/fed. Fadden and space planting was 20 cm between rows. The experimental plot area was 7 m² (1 × 7 m), while the experimental main plot area was 59.5 m² (7 × 8.5). There was 33 rows in each plot spaced 20 cm apart. Calcium super phosphate (15.5% P₂O₅) was added before sowing at rate 150 (kg/fed) As well as, potassium was added as potassium sulphate (48-52%) at rate of 100 kg/fed [8], while ammonium added as ammonium sulfate (20.6%) at rate of 360 (kg/fed) In five equal portions throw the irrigation system. The first, second, third, forth and fifth portion were added after (19, 29, 52, 66 and 73) respectively from sowing date [9]. The plots were irrigated at each 7 days interval as spring irrigation.

Characteristics studied

A. Growth Characteristics:

1. Leaf area index (L.A.I) which taken at 90 days after sowing for two wheat variety. (L.A.I) was calculated as described by Watson (1958) as follows formula: LAI = leaf area per plant (cm²) /Ground area per plant (cm²).

2. Dry weight (g) per plant was recorded as the mean of 10 plants.

B. Yield and yield components:

1. Number of spikes per m² was determined from a random sample of one m² taken from each plot.

2. Grain yield (kg/Fed) which determined from all plants in each plot.

3. Harvest index was calculated as: HI = Economic yield (kg/fed) / Total Biological yield (kg/fed) *100.

4. 1000-grain Weight (g) was obtained from the weight of 1000 kernels taken at random from each plot.

5. Weight of grains (g) per spike.

| LOCATION | DEPTH(CM) | PH(1:2.5) | EC(ppm) | TOTAL N(ppm) | ORGANIC MATTER (%) |
|----------|-----------|-----------|---------|--------------|-------------------|
| El Beheira | 30 cm | 7.22 | 112.3 | 46 | 0.23 |
| | 60 cm | 7.59 | 112.3 | 39 | 0.72 |
| | 90 cm | 7.50 | 131 | 31 | 0.75 |

Table 1: Chemical analysis of soil in El Beheira site.

| LOCATION | SAMPLE DEPTH(CM) | % clay | % sand | % silt | TEXTURE |
|----------|------------------|--------|--------|--------|---------|
| El Beheira | 30 cm | 8.88 | 8 | 83.12 | Loamy sand |
| | 60 cm | 6.88 | 6 | 87.12 | Sand |
| | 90 cm | 4.88 | 6 | 89.12 | sand |

Table 2: Mechanical analysis of soil in El Beheira site.

| Micronutrients(ppm) | Macronutrients (%) |
|---------------------|--------------------|
| Fe | Mn | Zn | Cu | N  | P  | K  |
| 776 | 534 | 52 | 18 | 0.76 | 0.11 | 1.14 |

Table 3: Chemical analyses for compost fertilizer sample.

6. No. of grains/spike: was recorded from a sample of 10 main spikes collected from 10 randomly selected plants in each plot.

Statistical analysis

In both of seasons, the treatments were arranged in split split design in three replicates [10]. The main plots were randomly devoted to the three levels of water irrigation quantity, the sub plots were randomly devoted to the three rates of compost fertilizer, the sub-sub plots were randomly assigned to the two wheat varieties. The mean values were compared at 5% level of significance using least significant differences (L.S.D) test.

Results and Discussion

Effect of irrigation treatments

The results presented in Tables 4-7 indicated that irrigation treatments had significant effect on all growth, yield and its components tasted during the experimental seasons of 2009/2010 and 2010/2011. Wheat leaf area (cm²)/plant, dry weight (gm)/plant, No. spikes/m², weight of grains/spike, No of grains/spike, weight of 1000 grains, economic yield (kg/fed) and harvest index were increased significantly by (12.82% and 20%), (75.5% and 58.1%), (28.7% and 17.0%), (19.7% and 20.1%), (11.1% and 9.3%), (16.2% and 13.3%), (65.82% and 43.45%), and (22.2% and 28.94%) respectively by adding water irrigation at the level of 90% from evapotranspiration (ET) as compared with the application of 60% from E.T.P which awarded the lowest values for that treats during 2009/2010 and 2010/2011 season respectively [11]. These results may be due to water defect during either of vegetative and pre-flowering stages which led to decrease water supply and nutrients which led to decrease leaf area /plant and dry weight/plant furthermore containing of water lack starting from developing flowers primordial till ovules fertilization may be led to the low appearance of florets primordial and decrease fertile flowers which in turn reduced No. of grains/spike and economic yield /fed. And harvest index but under the condition of 90% of ET may be increased nutrient uptake and adequate supply of them to wheat plants for proper growth and metabolic process. These results also confirmed by Ref. [1,2,12-14].

Effect of compost fertilizer rates

With regard to compost fertilizer rates as organic matter, data of the previous studied characters recorded in Tables 4-7 revealed that adding the organic matter as compost at the rate of 6 ton/fed. Led to increase all the values of the previous studied characters, significantly during the two experimental seasons, as compared with the lowest rate of 2 ton/fed. For example, in 2009/2010 season adding 6 ton/fed. Led to gain the greatest values for leaf area/plant (298 cm²/plant), dryweight/ plant (9.71 gm), No. of spikes/m² (447.8), No. of grains/spike (84.8), economic yield (2458 kg./fed.) and harvest index (0.43). These results may be attributed with increase the addition of compost rate to 6 ton/fed. Increased the exchangeable capacity of sandy soil, also may be led to increase the collecting of soil particles to improve its water holding capacity and its action exchange capacity. Similar results were obtained by [15,16].

Variance between varieties

Results presented in Tables 4-7 revealed that wheat varieties (sakha 93 and Gemmieza 9) were differed significantly in its leaf area/plant, dry weight/plant, No. of spikes/plant, grain weight/plant, No. of grains/spike, 1000 grain weight,economic yield/fed. And harvest index during the two seasons [17]. Results revealed that Gemmieza 9 wheat variety
Table 4: Quantity of water irrigation and compost levels affecting No. of grains per spike and Weight of 1000 grains (gm) for (sakha93, jemmieza9) Wheat varieties at harvest stage in 2009/2010 and 2010/2011 at El Busily experiment.

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| Character               | No. of grains per spike | Weight of 1000 grains (gm) |
|-------------------------|-------------------------|----------------------------|
|                         | First season 2009/2010  | Second season 2010/2011    |
|                         | First season 2009/2010  | Second season 2010/2011    |
| Irrigation              | V1  | V2  | Mean | V1  | V2  | Mean | V1  | V2  | Mean | V1  | V2  | Mean |
| (2 ton) C1              | 62.0| 67.0| 64.5 | 65.0| 70.0| 68.0 | 32.9| 40.0| 36.5 | 36.0| 41.0| 38.5 |
| I 1 (60%)               | 68.0| 74.0| 71.0 | 72.0| 78.0| 75.0 | 40.0| 45.2| 42.6 | 42.5| 45.7| 44.1 |
| (4 ton) C2              | 77.0| 79.0| 78.0 | 81.0| 83.0| 82.0 | 41.5| 47.7| 44.6 | 46.2| 48.5| 47.4 |
| Mean                    | 69.0| 73.3| 71.2 | 73.0| 77.0| 75.0 | 38.1| 44.3| 41.2 | 41.6| 45.1| 43.3 |
| (2 ton) C1              | 65.0| 67.0| 66.0 | 68.0| 70.0| 69.0 | 43.3| 48.9| 46.1 | 42.6| 45.3| 44.0 |
| I 2 (70%)               | 71.0| 71.0| 71.0 | 74.0| 80.0| 77.0 | 45.2| 47.5| 46.4 | 41.3| 45.3| 43.3 |
| (4 ton) C2              | 80.0| 91.0| 85.5 | 83.0| 94.0| 89.0 | 45.5| 47.7| 46.6 | 46.8| 45.0| 48.7 |
| Mean                    | 72.0| 76.3| 74.2 | 75.0| 81.0| 78.0 | 44.7| 48.0| 46.4 | 43.6| 47.0| 45.3 |
| (2 ton) C1              | 68.0| 71.0| 69.5 | 70.0| 73.0| 72.0 | 48.0| 45.4| 46.7 | 46.3| 48.5| 47.4 |
| I 3 (90%)               | 76.0| 78.0| 77.0 | 79.0| 81.0| 80.0 | 47.0| 48.8| 47.9 | 48.0| 49.5| 48.8 |
| (4 ton) C2              | 86.0| 96.0| 91.0 | 88.0| 98.0| 93.0 | 45.7| 52.2| 49.0 | 48.8| 53.5| 51.2 |
| Mean                    | 76.7| 81.7| 79.2 | 79.0| 84.0| 82.0 | 46.9| 48.8| 47.9 | 47.7| 50.5| 49.1 |
| G.M. V                  | 72.6| 77.1| 74.8 | 76.0| 81.0| 78.0 | 43.2| 49.2| 46.7 | 47.3| 50.8| 49.1 |
| G.M. V x C              | 3.1 | 3.10| 0.69 | 2.43|
| I =                     | 2.4 | 2.45| 0.71 | 1.99|
| C=                      | 1.4 | 1.43| 0.77 | 0.82|
| V =                     | 4.2 | 4.24| 1.23 | 3.44|
| I x C =                 | 2.5 | 2.48| 1.33 | 1.42|
| I x V =                 | 2.5 | 2.48| 1.33 | 1.42|
| C x V =                 | 4.3 | 4.29| 2.31 | 2.45|
| I x C x V =             | 2.48| 44.7| 43.5| 4.93|
| LSD at 5%               |     |     |     |     |
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Table 5: Quantity of water irrigation and compost levels affecting No. spikes per m² and Weight of grains (gm) per spike for (sakha93, jemmieza9) Wheat varieties at harvest stage in 2009/2010 and 2010/2011 at El Busily experiment.

| Character                          | Economic yield (kg./fed.) | Harvest index |
|------------------------------------|---------------------------|---------------|
|                                    | First season 2009/2010    |   Second season 2010/2011 |   First season 2009/2010 |   Second season 2010/2011 |
|                                    | V1 | V2 | Mean | V1 | V2 | Mean | V1 | V2 | Mean | V1 | V2 | Mean |
| I 1 (60%)                          | (2 ton) C1 | 1310 | 1348 | 1329 | 1650 | 1965 | 1808 | 0.30 | 0.34 | 0.32 | 0.33 | 0.35 | 0.34 |
|                                    | (4 ton) C2 | 1553 | 1657 | 1605 | 1915 | 2049 | 1982 | 0.32 | 0.40 | 0.36 | 0.36 | 0.42 | 0.39 |
|                                    | (6 ton) C3 | 1624 | 2267 | 1946 | 2008 | 2643 | 2326 | 0.38 | 0.40 | 0.39 | 0.38 | 0.42 | 0.40 |
| Mean                               | (2 ton) C1 | 1496 | 1757 | 1627 | 1858 | 2219 | 2039 | 0.33 | 0.38 | 0.36 | 0.36 | 0.40 | 0.38 |
|                                    | (4 ton) C2 | 1934 | 2278 | 2106 | 2014 | 2841 | 2428 | 0.37 | 0.40 | 0.39 | 0.39 | 0.45 | 0.42 |
|                                    | (6 ton) C3 | 2250 | 2435 | 2343 | 2730 | 2957 | 2844 | 0.40 | 0.43 | 0.42 | 0.44 | 0.46 | 0.45 |
| Mean                               | (2 ton) C1 | 1862 | 2168 | 2015 | 2238 | 2867 | 2553 | 0.37 | 0.40 | 0.39 | 0.39 | 0.43 | 0.41 |
|                                    | (4 ton) C2 | 2155 | 2641 | 2398 | 2328 | 3050 | 2689 | 0.36 | 0.45 | 0.41 | 0.37 | 0.45 | 0.41 |
|                                    | (6 ton) C3 | 2445 | 2774 | 2610 | 2516 | 3176 | 2846 | 0.39 | 0.47 | 0.43 | 0.46 | 0.58 | 0.52 |
| Mean                               | (2 ton) C1 | 1970 | 2256 | 2113 | 2250 | 2760 | 2505 | 0.37 | 0.42 | 0.40 | 0.40 | 0.46 | 0.43 |
| G.M. V.                             | (2 ton) C1 | 1622 | 1927 | 1775 | 1982 | 2606 | 2294 | 0.34 | 0.39 | 0.36 | 0.35 | 0.39 | 0.37 |
|                                    | (4 ton) C2 | 1977 | 2236 | 2107 | 2148 | 2689 | 2419 | 0.36 | 0.42 | 0.39 | 0.40 | 0.48 | 0.44 |
|                                    | (6 ton) C3 | 2311 | 2605 | 2458 | 2619 | 2987 | 2803 | 0.41 | 0.45 | 0.43 | 0.43 | 0.50 | 0.47 |
| LSD at 5%                           | I = 29.1 | 41.2 | 0.005 | 0.005 |
|                                    | C = 22.3 | 28.3 | 0.003 | 0.005 |
|                                    | V = 15.5 | 8.2 | 0.002 | 0.003 |
|                                    | I x C = 38.6 | 49.1 | 0.007 | 0.008 |
|                                    | I x V = 26.8 | 14.3 | 0.003 | 0.005 |
|                                    | C x V = 26.8 | 14.3 | 0.003 | 0.005 |
|                                    | I x C x V = 46.4 | 24.7 | 0.006 | 0.009 |

Table 6: Quantity of water irrigation and compost levels affecting economic yield (kg/fed.) and harvest index for (sakha93, jemmieza9) Wheat varieties at harvest stage in 2009/2010 and 2010/2011 at El Busily experiment.

| Character                          | Leaf area (cm²) per plant | Dry weight (gm) per plant |
|------------------------------------|---------------------------|---------------------------|
|                                    | First season 2009/2010    |   Second season 2010/2011 |   First season 2009/2010 |   Second season 2010/2011 |
|                                    | V1 | V2 | Mean | V1 | V2 | Mean | V1 | V2 | Mean | V1 | V2 | Mean |
| I 1 (60%)                          | (2 ton) C1 | 256 | 262 | 259 | 354 | 360 | 357 | 5.71 | 6.65 | 6.18 | 5.95 | 10.05 | 8.00 |
|                                    | (4 ton) C2 | 273 | 269 | 271 | 370 | 366 | 368 | 5.96 | 7.86 | 6.91 | 7.78 | 9.93 | 8.86 |
|                                    | (6 ton) C3 | 283 | 293 | 288 | 381 | 390 | 386 | 5.96 | 8.20 | 7.08 | 8.61 | 12.30 | 10.46 |
| Mean                               | (2 ton) C1 | 271 | 275 | 273 | 368 | 372 | 370 | 5.88 | 7.57 | 6.72 | 7.45 | 10.76 | 9.10 |
|                                    | (4 ton) C2 | 283 | 293 | 288 | 392 | 402 | 397 | 6.05 | 8.21 | 7.13 | 10.95 | 14.78 | 12.87 |
|                                    | (6 ton) C3 | 286 | 301 | 293 | 394 | 410 | 402 | 9.93 | 7.55 | 8.74 | 11.45 | 15.30 | 13.38 |
| Mean                               | (2 ton) C1 | 277 | 300 | 288 | 386 | 408 | 397 | 7.27 | 8.52 | 7.90 | 10.58 | 14.68 | 12.63 |
|                                    | (4 ton) C2 | 293 | 310 | 302 | 429 | 446 | 438 | 10.18 | 11.08 | 10.63 | 12.10 | 14.92 | 13.51 |
|                                    | (6 ton) C3 | 307 | 320 | 314 | 443 | 462 | 455 | 11.06 | 15.56 | 13.31 | 13.33 | 17.82 | 15.58 |
| Mean                               | 298 | 319 | 308 | 434 | 455 | 444 | 10.61 | 12.99 | 11.80 | 12.59 | 16.18 | 14.39 |
| G.M. V.                             | (2 ton) C1 | 282 | 298 | 290 | 396 | 412 | 404 | 7.92 | 9.69 | 8.81 | 10.21 | 13.87 | 12.04 |
|                                    | (4 ton) C2 | 283 | 296 | 290 | 397 | 404 | 397 | 7.53 | 9.47 | 8.50 | 10.36 | 13.50 | 11.93 |
Table 7: Quantity of water irrigation and compost levels affecting leaf area (cm²) and Dry weight (gm) per plant for (sakha93, jemmieza9) Wheat varieties at harvest stage in 2009/2010 and 2010/2011 at El busily experiment.

| (6 ton) C3 | 292 | 305 | 298 | 406 | 425 | 418 | 8.98 | 10.44 | 9.71 | 11.13 | 15.14 | 13.14 |
|-----------|-----|-----|-----|-----|-----|-----|------|-------|------|-------|-------|-------|
| I =       | 13.27 | 16.54 |     |     |     |     | 0.78 |       | 2.01 |       |       |       |
| C=        | 14.27 | 17.54 |     |     |     |     | 0.59 |       | 3.01 |       |       |       |
| V=        | 15.27 | 18.54 |     |     |     |     | 0.34 |       | 4.01 |       |       |       |
| I x C =   | 16.27 | 19.54 |     |     |     |     | 0.95 |       | 5.01 |       |       |       |
| I x V =   | 17.27 | 20.54 |     |     |     |     | 0.51 |       | 6.01 |       |       |       |
| C x V =   | 18.27 | 21.54 |     |     |     |     | 0.51 |       | 7.01 |       |       |       |
| I x C x V | 19.27 | 22.54 |     |     |     |     | 0.82 |       | 8.01 |       |       |       |

The interaction effect of factors under study

Irrigation level × compost rates interaction had significant effect on leaf area/plant, dry weight/plant, No. of spikes/plant, grain weight/plant, No. of grains/spike, 1000 grain weight, economic yield/fed. And harvest index in 2009/2010 and 2010/2011 seasons. Results revealed that all above mentioned measurements increased gradually by increasing the quantity of water irrigation from 60% to 70% and 90% of evapotranspiration rate of wheat and by increasing the compost level from 2 ton to 4 and 6 ton/fed [18]. Improved of utilization of the high quantity of water irrigation which reflected to increase the above mentioned traits. Results also revealed that wheat varieties tested differed significantly under the irrigation levels tested.

Gemmeiza 9 wheat variety scored the greatest values for the above mentioned characters through all irrigation levels as compared with sakha 93 under the effect of the same irrigation treatments during the two seasons. As for compost levels x wheat varieties interaction effect [19-21]. Results in Tables 4-7 show significant measured characters during the two seasons. Gemmieza 9 wheat variety showed its superiority under the condition of each of 2 or 4 or 6 ton compost / fed, regarding to the second order interaction irrigation × compost × wheat varieties. Results in Tables 4-7 Revealed that Gemmitza 9 wheat plants utilized the greatest amount of water irrigation at the level of 90% of transpiration rate under the condition of 6 ton /fed. Compost get the significant greatest values of leaf area/plant, dry weight/plant, No. of spikes/plant, grain weight/plant, No. of grains/spike, 1000 grain weight, economic yield/fed and harvest index as compared with the other treatments during the two experimental seasons.

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