Effect of Magnetization of Nano Fertilization on The Growth and Yield of Wheat Triticum Aestivum L.

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Abstract
A field experiment was conducted in Al-Fadhiliya city, Dhi Qar province during the winter agricultural season 2019 - 2020 for the purpose of studying the effect of magnetization of nano Fertilization on the growth and yield of wheat. The experiment was carried out according to Split Plot Design and using the RCBD Design with three replications. The first factor included Magnetization levels of the Nano Fertilization (Gs) (0 Gs (Gs1), 750 Gs (Gs2), 1500 Gs (Gs3) for 15 minute (in main plot) while the second factor included the Nano Fertilization levels for (N,P) (F) 1 Kg.ha°1 (F1), 1.5 Kg.ha°1 (F2), 2 Kg.ha°1 (F3) (according to the recommendation of the manufacturer (1 - 2 Kg.ha°1)) (in sub plot). Mineral fertilizer add for (N, P) by 120 Kg N .ha°1, 100 Kg P ha°1. Mineral and nano fertilizer section for three growth stages (ZGs21, ZGs32, ZGs49). The results showed a positive response to the studied traits of variety Bohouth 22 (Plant height, number of tillers, number of grains and total grain yield) given the highest averages at the level of magnetism (Gs3) and fertilization level (F3)(109.33 cm, 426.2 tiller.m°2, 73.22 grain.spike°1, 1.859 t.d°1), (108.44 cm, 471.4 tiller.m°2, 77.78 grain.spike°1, 1.915 t.d°1) respectively, while the level of magnetism (Gs1) and fertilization level (F1) giving the lowest averages (95.11 cm, 341.3 tiller.m°2, 60.11 grain.spike°1, 1.437 t.d°1), (96.22 cm, 312.1 tiller.m°2, 54.00 grain.spike°1, 1.412 t.d°1) respectively. The level of magnetism (Gs1) and fertilization level (F1) gave the highest average in weight 1000 grain (43.188, 44.266)g respectively, while the magnetization level (Gs3) and fertilization level (F3) giving the lowest average (42.092, 41.182)g respectively. Interaction treatment (Gs3F3) gave the highest average grain yield 2.1773 t.d°1 while the interaction treatment (Gs1F1) gave the lowest average attained 1.218 t.d°1.

Keywords: Nano fertilization, Magnetization, Growth Characteristics, Grain Yield.

1. Introduction

1.1 The importance of Magnetization

In recent years, modern patterns, methods and technologies have emerged, including magnetic technology or the so-called bio-magnetic stimulation to raise the productivity of agricultural crops by creating stimuli in plant metabolism and changes in the properties of plant cell walls membranes, magnetization means shedding a magnetic field and within a certain intensity for the purpose of activating vital activities and increasing readiness nutrients, which increases the speed of their absorption, because these elements will change their arrangement and organization when exposed to a magnetic field and thus they pass readily and quickly through cell membranes [1]. As it was observed that the magnetic field positively affected the activity of enzymes and led to changes in the characteristics or properties of the cell membrane, its metabolism and division and affected the functions of mRNA and on gene expression and protein biosynthesis, as well as other changes at the level of tissue and plant organ and an increase in the proportion of chloroplasts [2].

1.2 The importance of Nano fertilization

Nanotechnology and nano fertilization are of interest to many researchers in the world, as they are among the most promising modern technologies that promise a huge leap in the field of agricultural production [3], they are known Nano materials as those materials whose minute sizes (1 - 100 nanometer), due to the size of these materials, they behave differently to the behavior of traditional materials that are large in the size of their particles, as well as in their physical and chemical properties [4].
1.3 Aim of study

Adding nano fertilizers by spraying on the shoot can increase the satisfaction of the plant basic need for nutrients, as well as being highly efficient in delivering nutrients to the plant compared to adding them to the soil if used according to plant requirements, and despite the advantages of leaf feeding however, it is not a substitute for ground fertilization, but rather is a complement to it [5]. The aim of this study is to know the effect of magnetization of the nano fertilizer sprayed on the shoots on the growth characteristics and the yield of the Bohouth 22.

2. Materials and Methods

2.1 Experiment factors

A field experiment was carried out in Al-Fadhiliya city, Dhi Qar province during the winter agricultural season 2019 - 2020. The experiment was carried out according to Split Plot Design and using the RCBD Design with three replications. The experiment included two factors, the first factor included Magnetization levels of the Nano Fertilization (Gs) (0 Gs (Gs1), 750 Gs (Gs2), 1500 Gs (Gs3) for 15 minute (in main plot) [6], the magnetic strength of the compost magnetizing devices was measured (diameter 2 ang) by device Gaussmeter in the Ministry of Science and Technology. The second factor included the Nano Fertilization levels for (N, P) (F) 1 Kg.ha⁻¹(F1), 1.5 Kg.ha⁻¹(F2), 2 Kg.ha⁻¹(F3) (according to the recommendation of the manufacturer (1 - 2 Kg.ha⁻¹))( in sub plot).

2.2 Field operation

The experiment included three blocks by reality 9 experimental units for each block and dimensions (2 × 2) m, the experimental units contained ten agricultural lines and a distance 20 cm between the lines. variety Bohouth 22 seeds were sown 15 / 11 / 2019 at a rate 120 Kg. ha⁻¹. Mineral fertilizer add for (N, P ) by 120 Kg N .ha⁻¹, 100 Kg P ha⁻¹ [7]. Mineral and nano fertilizer section for three growth stages (ZGs21 Tillering, ZGs32 Stem Elongation, ZGs49 Boot). Harvest the crop on a date 20/4/2020.

2.3 Study of traits

Traits were studied (plant height (cm), number of tillers (tiller.m⁻²), the number of grains per spike (grain.spike⁻¹), weight 1000 grain (g) and total grain yield (t.d⁻¹))

2.4 Statistical analysis

The data were analyzed statistically according to the design used by the statistical program Genstat Version 12, the averages were compared with the lowest significant difference LSD at the level of probability 0.05.

3. Results and Discussion

3.1 Plant height (cm)

Results show of table (1) and figure (1,2) the significant effect of the magnetization levels, the levels of the nano fertilizer and the overlap between them on the characteristic of plant height. The level of magnetism (Gs3) exceeding by giving the highest average for plant height reached 109.33 cm while the level of magnetism (Gs1) gave the lowest average attained 95.11 cm. The reason may be attributed to the passage of the nano fertilizer (fluid) through a magnetic field that disintegrates or changes the hydrogen bonds or bonds that bind the fluid to each other, and that this disintegration works to absorb energy, reduce the level of union of fluid molecules and increase the ability to dissolve [8]. The magnetic field also affects the angle of the bond between the oxygen and the two hydrogen atoms in the water molecule, which becomes smaller, and this in turn reduces the assembly of water molecules with each other, as well as the single molecule increase as a result of the collision of the single molecule with the water cluster, thus giving the ability to penetrate more easily into plant cell walls, and then increasing the amount of nutrients carried with water, in addition to that, other changes occur to the water molecules, such as increasing the size of the water molecule and thus increasing its solubility, reducing viscosity, surface tension and increasing the surface area, resulting in the ease of crossing of nutrient-loaded water molecules. This result agreed with [9].The level of fertilization (F3) exceeded by giving the highest average reached 108.44 cm while the level fertilization (F1) gave the lowest average attained 96.22 cm. The reason may be due to the level of fertilization (F3) it provided nutritional support and thus increased gibberellins (GA) in plants [10], which have a major effect on the elasticity and plasticity of plant cell walls and then elongate them, the food supply has also contributed to increasing the efficiency of biological processes, including making
food, encouraging the production of amino acids and enzymes that stimulate the increase in cell division and increase the activity of antioxidant enzymes, which leads to regulating plant growth and promoting his activity. This result agreed with [11]. Interaction treatment (Gs3F3) outperformed by giving it the highest average 116.00 cm while the interaction treatment (Gs1F1) gave the lowest average reached 91.00 cm. The magnetization of the nano fertilizer has led to an increase in the size of the fluid particles, thus increasing the solubility, reducing the viscosity and surface tension, and increasing the surface area of the fluid particles, resulting in the ease of crossing the nutrient-loaded fluid particles [12].

### Table 1. Plant height (cm) under the influence of magnetization of nano fertilization

| Treatment | Gs1  | Gs2  | Gs3  | Mean | LSD  |
|-----------|------|------|------|------|------|
| F1        | 91.00| 96.67| 101.00| 96.22|      |
| F2        | 95.33| 106.67| 111.00| 104.33| 1.089|
| F3        | 99.00| 110.33| 116.00| 108.44|      |
| Mean      | 95.11| 104.56| 109.33|      |      |
| LSD       |      | 1.073|      |      | 1.858|

### 3.2 Number of Tillers (tiller.m⁻²)

Table (2) and figure (1,2) show up the moral superiority of the level of magnetism (Gs3) by giving the highest average reached 426.2 tiller.m⁻² while the level of magnetism (Gs1) gave the lowest average attained 341.3 tiller.m⁻². This difference may be attributed to the high melting point of the magnetized fluid at a level (Gs3) compared with the level of magnetism (Gs1). Thus, having more energy leads to an increase in the activity of its ions and its wide and rapid movement, and this leads to a greater ability to transport nutrients into the plant. This result was in agreement with [7]. The level of fertilization (F3) exceeded by giving the highest average reached 471.4 tiller.m⁻² while the level of fertilization (F1) gave the lowest average attained 312.1 tiller.m⁻². Provide (N, P) the quantity required for the plant leads to an increase in the vegetative growth of the plant (table 1) especially during the different stages of plant growth, which represents an increase in the total dry matter of the plant and that the increase in vegetative growth leads to an increase in the utilization of effective sunlight, which leads to the availability of representative materials that support the emergence of tillers and the success of their growth and continuation [8], on the one hand, and on the other hand the availability of periods Nutritional intake by nano fertilizer may increase the growth of the root system and the production of cytokines, and export them to the vegetative part, which reduces the activity of auxins, thus stimulating the plant to produce new tillers. This result was in agreement with [1]. Interaction treatment (Gs3F3) gave the highest average 525.3 tiller.m⁻² while the interaction treatment (Gs1F1) gave the lowest average attained 304.3 tiller.m⁻² this result from the increased magnetization effect at a level F3.

### Table 2. Number of tillers (tiller.m⁻²) under the influence of magnetization of nano fertilization.

| Treatment | Gs1  | Gs2  | Gs3  | Mean | LSD  |
|-----------|------|------|------|------|------|
| F1        | 304.3| 310.7| 321.3| 312.1|      |
| F2        | 307.3| 336.0| 432.0| 358.4| 9.37 |
| F3        | 412.3| 476.7| 525.3| 471.4|      |
| Mean      | 341.3| 374.4| 426.2|      |      |
| LSD       | 6.41 |      |      |      | 11.10|

### 3.3 The number of grains (grain.spike⁻¹)

Notes from table (3) and figure (1,2) there was a significant effect of magnetization levels and fertilization levels, and the overlap between them in this characteristic. The level of magnetism (Gs3) exceeding by giving the highest average reached 73.22 grain.spike⁻¹ while the level of magnetism (Gs1) gave the lowest average attained 60.11 grain.spike⁻¹. The reason may be due to the fact that the magnetization of the nano fertilizer has reduced the number and strength of the hydrogen bonds, which reduced the viscosity of the fluid and increased its diffusion in the plant, obtaining better absorption of nutrients and increasing the total dry matter (table 2) thus increasing the transport of dry matter from the source to sinks and increasing the number of grains in the spike. This result agreed with [6]. The level of fertilization (F3) exceeded by giving the highest average 77.78 grain.spike⁻¹ while the level of fertilization (F1) gave the lowest average attained 54.00 grain.spike⁻¹. The increase in the number of seeds per spike may be due to the role of fertilization level (F3) in improving the fertility status of most of the florets in the spike and making them more ready to contract and form grains compared to the fertilization level (F1). This result agreed with [3]. Interaction treatment (Gs3F3) gave the highest average reached 82.67 grain.spike⁻¹ while the
interaction treatment (Gs1F1) gave the lowest average attained 47.33 grain.spike\(^{-1}\). This shows the importance of magnetizing the nano fertilizer at a level Gs3.

Table 3. Number of grain (grain.spike\(^{-1}\)) under the influence of magnetization of nano fertilization

| Treatment | Gs1 | Gs2 | Gs3 | Mean | LSD   |
|-----------|-----|-----|-----|------|-------|
| F1        | 47.33 | 53.67 | 61.00 | 54.00 | 1.421 |
| F2        | 62.67 | 71.00 | 76.00 | 69.89 |
| F3        | 70.33 | 80.33 | 82.67 | 77.78 |
| Mean      | 60.11 | 68.33 | 73.22 |
| LSD       | 1.348 |       |       |       |

3.4 Weight 1000 Grain (g)

Results indicate of table (4) and figure (1, 2) for the significant effect of magnetization levels and nano fertilizer levels and the overlap between them. The level of magnetism (Gs1) exceeding by giving the highest average reached 43.188 g while magnetism level (Gs3) gave the lowest average attained 42.092 g. It appears to be a weight 1000 grain has a negative association with the adjective of the number of tillers and the number of grains. The level of fertilization (F1) exceeded by giving the highest average reached 44.266 g while the level of fertilization (F3) gave the lowest average attained 41.186 g. That the level of low weight 1000 grain at fertilization level (F3) mainly refer to the number of grains per spike and thus increase competition for nutrients per spike (table 3). Interaction treatment (Gs1F1) outperformed by giving it the highest average 44.603 g while the interaction treatment (Gs3F3) gave the lowest average attained 40.783 g, the reason is due to the reasons mentioned in the discussion of the above factors.

Table 4. Weight 1000 grain (g) under the influence of magnetization of nano fertilization.

| Treatment | Gs1 | Gs2 | Gs3 | Mean | LSD   |
|-----------|-----|-----|-----|------|-------|
| F1        | 44.603 | 44.230 | 43.963 | 44.266 |
| F2        | 43.463 | 42.623 | 41.530 | 42.539 |
| F3        | 41.497 | 41.277 | 40.783 | 41.186 |
| Mean      | 43.188 | 42.710 | 42.092 |
| LSD       | 0.125 |       |       |       |

3.5 Total grain yield (t.d\(^{-1}\))

The results demonstrated the significant effect of the levels of magnetization and nano fertilization, and the interaction between them on this characteristic. Observed from a table (5) the magnetization level (Gs3) exceeds by giving the highest average for grain yield reached 1.859 t.d\(^{-1}\) while the level of magnetism (Gs1) gave the lowest average attained 1.437 t.d\(^{-1}\). The increase in the total grain yield at the level of magnetization (Gs3) is due to the positive role of this level in increasing the nutrient readiness of the plant during the growth stages and increasing the efficiency of the photosynthesis process, and thus the positive effect on increasing the number of tillers and the number of grains (table 2, 3) which are two of the most important components of the total grain yield. This result agreed with [6]. The level of fertilization (F3) exceeded by giving the highest average of total grain yield 1.915 t.d\(^{-1}\) while the level of fertilization (F1) gave the lowest average attained 1.412 t.d\(^{-1}\). That the level of fertilization (F3) it provided the nutrients in a larger quantity, which led to the significant increase in the growth traits and yield components, which was reflected in the increase in the total grain yield. This result agreed with [2]. Interaction treatment (Gs3F3) gave the highest average reached 2.177 t.d\(^{-1}\) while the interaction treatment (Gs1F1) gave the lowest average attained 1.218 t.d\(^{-1}\). This confirms the effect of magnetizing the nano fertilizer at the level of F3.

Table 5. Total grain yield (t.d\(^{-1}\)) under the influence of magnetization of nano fertilization.

| Treatment | Gs1 | Gs2 | Gs3 | Mean | LSD   |
|-----------|-----|-----|-----|------|-------|
| F1        | 1.218 | 1.481 | 1.537 | 1.412 |
| F2        | 1.481 | 1.855 | 1.862 | 1.733 |
| F3        | 1.612 | 1.954 | 2.177 | 1.915 |
| Mean      | 1.437 | 1.763 | 1.859 |
| LSD       | 0.008 |       |       |       |

| LSD of FxGs | 0.014 |
Figure 1. The effect of magnetism levels on the studied traits.

Figure 2. The effect of nano fertilization levels on the studied traits.

Conclusions

There was a positive response to the studied characteristics of variety Bohouth 22 to magnetize nano fertilizer, especially at the level of magnetization 1500 Gs and the level of fertilization 2 Kg.ha⁻¹, this is reflect on the total grain yield.

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