Effect of Seed Stimulation With Gibberellin and Use of Mineral and Nano Fertilization on Growth and Yield of Wheat Triticum aestivum L.

Al-Saidan Khudhair Joudah Yasir

1Marshes Research Center, University of Thi-Qar, Iraq.

Email: khudhair@utq.edu.iq

Abstract

A field experiment was carried out in Al-Fadhiliya city, Dhi Qar province during the winter agricultural season 2019-2020 to find out the effect of stimulation (soaking) wheat seeds with gibberellin and use of mineral and nano fertilization on some growth and yield characteristics of the Ibaa variety 99. Using RCBD Design with split plot arrangement with three replications. The first factor (main plot) included fertilization levels (F) mineral fertilizer recommendation for N, P (F1), Nano fertilizer recommendation for N, P (F2) and 0.5 mineral fertilizer recommendation + 0.5 Nano fertilizer recommendation (F3). The second factor (sub plot) included the seed stimulation levels (drenching) with gibberellin (G) for 12 hour: 0.0 mg.G.L^{-1} (water only) (G1), 50 mg G.L^{-1} (G2), 100 mg G.L^{-1} (G3). The results showed superior the level of fertilization (F3) in traits (plant height 110.33 cm, flag leaf area 54.45 cm², number of tillers 389.00 tiller.m⁻², number of grains per spike 67.11 grain.spike⁻¹, grain yield 7.589 t.ha⁻¹). While, the level of fertilization (F2) exceeding in adjective (weight 1000 grain 49.18 g). However, the level of stimulation (G2) superior in traits (plant height 106.00 cm, flag leaf area 54.267 cm², number of tillers 381.44 tillers.m⁻² and the total grain yield 7.344 t.ha⁻¹). Whereas, the level of stimulation (G3) exceeding in adjective (number of grain per spike 71.22 grain.spike⁻¹ and weight 1000 grain g). Interaction treatment (F3G2) gave the highest average of total grain yield by 8.133 t.ha⁻¹.

Keywords: Mineral Fertilization, Nano Fertilization, Stimulation, Gibberellin.

1.Introduction

Nanotechnology is considered as a new scientific revolution on which the world stands today is no less important than the industrial or technological revolution. it has become the focus of great attention of the world, due to the chemical and physical properties that nanomaterials possess. Recently, It has used in all areas of life including agricultural field and their use has expanded in the production of agricultural fertilizers for reducing the loss upon application and the speed of its effect and reaching what conventional fertilizers cannot reach [1]. The success of the germination process is considered the thread of life that guarantees the survival of all plant species and the increase of seeds, and it is a key to modern agriculture, therefore a deep understanding of the germination process becomes something necessary to achieve the maximum yield of the crop [2]. The technique of using growth regulators such are considered one of the important methods in modern agriculture, because, it is used in very low concentrations, as stimulating seeds leads to improved seedling growth and growth characteristics, generally which it leads to an increase in yield. The use of growth regulators is one of the biological and chemical tools that help the plant use nutrients efficiently and exploit its physiological capacity at the highest levels. Gibberellin is one of the plant hormones that are built and produced within the various plant tissues, it had a major role in the development of plants during their life and growth cycle. [3]. This experiment was carried out with the aim of finding out the effect of stimulation (soaking) wheat seeds with different concentrations of gibberellin and use of mineral, nano fertilization and the interaction between them on the growth traits and components of yield for the Ibaa 99 variety.

2.Materials and Methods

A field experiment was carried out in Al-Fadhiliya city Dhi Qar province during the winter agricultural season 2019-2020 to find out the effect of stimulation (soaking) wheat seeds with gibberellin, use of mineral and nano fertilization and the interaction between them on some growth and yield characteristics of the Ibaa99 variety. RCBD Design Used with split plot arrangement with three replications. The first factor (main plot) included fertilization levels (F) mineral fertilizer recommendation for N, P (F1), nano fertilizer recommendation for N, P (F2), 0.5 mineral fertilizer recommendation and 0.5
nano fertilizer recommendation (F3). Whereas, the second factor (sub plot) included the seed stimulation levels (soaking) with gibberellin (G) for 12 hour: 0.0 mg G.L\(^{-1}\) stimulation with water only (G1), 50 mg G.L\(^{-1}\) (G2) and 100 mg G.L\(^{-1}\) (G3). Plowing, smoothing and leveling operations were conducted for the field. The experiment was divided into three blocks by reality nine experimental units for each block and dimensions (2 × 2) m\(^2\), the experimental unit contained ten agricultural lines with a distance 20 cm between the lines. Seeds of Ibaa99 variety planted in 16/11/2019 at a seed rate 120 Kg.ha\(^{-1}\). Mineral fertilizer used (urea\% 46 N average of 260 Kg.ha\(^{-1}\), Di-Ammonium phosphate fertilizer (DAP) 46% P\(_2\)O\(_5\) average of 200 Kg.ha\(^{-1}\). Furthermore, it used the nano fertilizer for N1 L.ha\(^{-1}\), for P1 Kg.ha\(^{-1}\) according to the recommendations of the manufacturer. Mineral and nano fertilizers added for three growth stages (ZGs21, ZGs32 and ZGs49). Harvest was done at complete maturity of the crop on 20/04/2020. Traits were studied (plant height (cm), flag leaf area (cm\(^2\)), number of tillers (m\(^{-2}\)), number of grain per spike, weight 1000 grain (g), total grain yield (t.ha\(^{-1}\)). The data were analyzed statistically according to the used design by the statistical program Genstat Version 12, the averages were compared with the least significant difference LSD at the level of probability 0.05.

3. Results and Discussion

3.1. Plant height (cm)

Results indicated of table (1) and figures (1,2) there were significant differences between fertilization levels and gibberelin stimulation levels and the interaction between them. The level of fertilization (F3) gave the highest average of plant reached 110.33 cm, while the level of fertilization (F2) gave the lowest average 99.22 cm. The increase in plant height due to the level of fertilization (F3) it is attributed to the availability of nutrients to both the root and vegetable parts. In addition to the importance of nano-fertilizers due to its unique and distinctive behavior and characteristics such as small particles and surface area, which enabled it to increase the speed of penetration, absorption and assimilation, then it increase the enzymatic activity, thus the speed of metabolic reactions, which leads to an increase in the efficiency of the photosynthesis process and the transfer of the resulting materials to all parts of the plant, including the root system, and thus increase its efficiency in absorbing the nutrients in the soil. This result agreed with [4].

The level of stimulation (G2) exceeding by giving the highest average of plant reached 106.00 cm, while the level of stimulation (G2) gave the lowest average 99.22 cm. The increase in plant height due to the level of fertilization (F3) it is attributed to the availability of nutrients to both the root and vegetable parts. In addition to the importance of nano-fertilizers due to its unique and distinctive behavior and characteristics such as small particles and surface area, which enabled it to increase the speed of penetration, absorption and assimilation, then it increase the enzymatic activity, thus the speed of metabolic reactions, which leads to an increase in the efficiency of the photosynthesis process and the transfer of the resulting materials to all parts of the plant, including the root system, and thus increase its efficiency in absorbing the nutrients in the soil. This result agreed with [5]. Interaction treatment (F3G2) gave the highest average reached 112.33 cm, while (F2G1) treatment gave the lowest average attained 97.67 cm. It may be attributed to what was mentioned in the discussion of single factors.

| Treatment | F1 | F2 | F3 | Mean | LSD G |
|-----------|----|----|----|------|------|
| G1        | 102.00 | 97.67 | 108.00 | 102.56 |
| G2        | 105.00 | 100.67 | 112.33 | 106.00 | 0.778 |
| G3        | 102.67 | 99.33 | 110.67 | 104.22 |
| Mean      | 103.22 | 99.22 | 110.33 |
| LSD F     | 0.778 |
| LSD GxF   | 1.348 |

3.2. Flag leaf Area (cm\(^2\))

The results of table (2) and figures (1,2) clarify the moral effect of the studied factors and the interaction between them. The level of fertilization (F3) exceeded by giving the highest average reached 54.456 cm\(^2\), whereas, the level fertilization (F2) gave the lowest average attained 50.478 cm\(^2\). It may be attributed to the level of fertilization (F3) it provided the nutritional supply of nutrients that have a great role in increasing the effectiveness of plant processes such as photosynthesis, respiration, and chlorophyll formation, as well as their entry into the formation of proteins, cell division processes, energy compounds, amino acids and nuclei, all of this increases the efficiency of the plant in absorbing water and nutrients and then increasing growth and leaf area. This result agreed with [6].
The level of stimulation (G2) exceeding by giving the highest flag leaf area average reached 54.267 cm², while the level of stimulation (G1) gave the lowest average attained 50.556 cm². That level of stimulation (G2) it stimulated the division, elongation and expansion of plant cells, especially in the developing meristematic ridges, as gibberellin increases the division and elongation of cells at the base of the leaf, increasing the length and width of the leaf accordingly. This result agreed with [4]. Interaction treatment (F3G2) gave the highest average reached 56.500 cm², while the (F2G1) treatment gave the lowest average attained 48.867 cm².

### Table 2. Flag leaf area (cm²) under the influence of mineral and nano fertilization and stimulation of gibberellin.

| Treatment | F1  | F2  | F3  | Mean | LSD G |
|-----------|-----|-----|-----|------|-------|
| G1        | 49.900 | 48.867 | 52.900 | 50.556 |
| G2        | 54.333 | 51.967 | 56.500 | 54.267 | 0.469 |
| G3        | 52.800 | 50.600 | 53.967 | 52.456 |
| Mean      | 52.344 | 50.478 | 54.456 |

LSD F 0.469  LSD G×F 0.812

### 3.3. Number of tillers (tiller.m⁻²)

Notes from table results (3) and figures (1,2) the moral effect of both factors and the interaction between them. The level of fertilization (F3) exceeding by giving the highest number of tillers in m⁻² average reached 389.00 tiller.m⁻², while the level of fertilization (F2) was given the lowest average attained 320.44 tiller.m⁻². On the one hand, the level of fertilization (F3) achieve a balance in providing the nutrients to the vegetative and root system together, and to increase the growth of the roots that form a site for the production of cytokinins and their export to the vegetative part, as their action is against the action of auxins and induces the plant to grow and produce new tillers. On the other hand, to provide fertilizer at the beginning of growth it encourages the growth and growth of the roots and the primary and secondary tillers. As for the availability of fertilizer in the phase of elongation and beyond, it causes decreasing in the percentage of death and survival of some tillers, causing an increase in the number of tillers. This result agreed with [7].

The level of stimulation (G2) exceeding by giving the highest average reached 381.44 tiller.m⁻², while the level of stimulation (G1) gave the lowest average attained 345.56 tiller.m⁻². That level of stimulation (G2) has improved the growth of plants, which helped the continuation of the greater number of tillers in the plant life cycle, thus increasing the number of tillers. This result agreed with [8]. Interaction treatment (F3G2) gave the highest average reached 416.00 tiller.m⁻², while the interaction (F2G1) gave the lowest average attained 304.33 tiller.m⁻².

### Table 3. Number of Tillers. m⁻² under the influence of mineral and nano fertilization and stimulation of gibberellin.

| Treatment | F1  | F2  | F3  | Mean | LSD G |
|-----------|-----|-----|-----|------|-------|
| G1        | 360.33 | 304.33 | 372.00 | 345.56 |
| G2        | 383.67 | 344.67 | 416.00 | 381.44 | 4.071 |
| G3        | 368.00 | 312.33 | 379.00 | 353.11 |
| Mean      | 370.67 | 320.44 | 389.00 |

LSD F 4.071  LSD G×F 7.051

### 3.4. The number of grain per spike (grain.spike⁻¹)

Results show of table (4) and figures (1,2) significant effects of fertilization levels, stimulation levels and the interaction between them. The level of fertilization (F3) exceeded by giving the highest number of grain per spike average reached 67.11 grain.spike⁻¹, while the level of fertilization (F2) gave the lowest average attained 50.44 grain.spike⁻¹. The reason may be due...
to the level of fertilization (F3) increased the readiness of the nutrients, thus it increased the efficiency of the photosynthesis process, increasing the metabolism products and providing an appropriate opportunity to reduce the state of abortion of the florets due to the state of competition among them for the food product, and it also had a positive role in the hormonal balance process, which it has a positive role in the development process the florets and the increase in pollen, which increases the possibility of fertilization of the florets and then the formation of grains. This result agreed with [6]. The level of stimulation (G3) exceeding by giving the highest number of grain per spike average reached 71.22 grain.spike\(^{-1}\), while the level of stimulation (G1) gave the lowest average attained 50.11 grain.spike\(^{-1}\).The reason may be due to the positive effect of gibberellin in increasing the percentage of fertile florets. It also may be plays an important and effective role in regulating the processes of flowering, fertilization, transmission of nutrients, grain emergence and thus increasing the number of grains in the spike. This result was in agreement with [7]. Interaction treatment (F3G3) gave the highest average reached 79.00 grain.spike\(^{-1}\) while the interaction treatment (F2G1) gave the lowest average attained 41.00 grain.spike\(^{-1}\).

Table 4. Number of grains per spike (grain. spike\(^{-1}\)) under the influence of mineral and nano fertilization and stimulation of gibberellin.

| Treatment | F1  | F2  | F3  | Mean | LSD G |
|-----------|-----|-----|-----|------|-------|
| G1        | 52.00 | 41.00 | 57.33 | 50.11 |       |
| G2        | 64.00 | 48.33 | 65.00 | 59.11 | 2.571 |
| G3        | 72.67 | 62.00 | 79.00 | 71.22 |       |
| Mean      | 62.89 | 50.44 | 67.11 |      |       |

3.5. Weight 1000 grain (g)

Results show of table (5) and figures (1,2) the moral effect of study factors and the interaction between them. The level of fertilization (F2) exceeding by giving the highest weight 1000 grain average reached 49.18 g, whereas, the level fertilization (F3) gave the lowest average attained 40.60 g. The reason may be attributed to the increase in the number of grains per spike at the level of fertilization (F3) as showed in table (4) this led to an increase in the state of competition within the same plant for photosynthesis products, which it resulted grains with less weight compared to grains at the level of fertilization (F2) because of the lack of materials needed to fill the grains, which negatively affected their weight, as an increase in one component of the outcome may lead to a decrease in the other component due to the compensation state. This result agreed with [1]. The level of stimulation (G3) exceeding by giving the highest weight 1000 grain average reached 46.69 g, while the level of stimulation (G1) gave the lowest average attained 42.06 g. The reason may be due to the effect of gibberellin in the stages preceding of the stage of grain formation, as treatment with gibberellin has a role in improving the vegetative growth of the plant and the accumulation of dry matter during the period before the formation of the grains, which it leads to an increase in the formation of nutrients represented and their arrival to the grains, increased stimulation from the source to sink, which it reflected positively on the weight of the grain. This result was in agreement with [7]. Interaction (F2G3) gave the highest average reached 50.97 g, whereas, (F3G1) treatment gave the lowest average attained 37.97 g, this is for the same reason when discussing the single factors.

Table 5. Weight 1000 Grain (g) under the influence of mineral and nano fertilization and stimulation of gibberellin.

| Treatment | F1   | F2   | F3   | Mean  | LSD G |
|-----------|------|------|------|-------|-------|
| G1        | 40.67| 47.53| 37.97| 42.06 |       |
| G2        | 43.97| 49.03| 47.53| 44.63 | 0.847 |
| G3        | 46.17| 50.97| 42.92| 46.69 |       |
| Mean      | 43.60| 49.18| 40.60|       |       |
| LSD       |      | LSD GxF | 0.847|       | 1.468 |
3.6. Total grain yield (t ha\(^{-1}\))

Results indicate of table (6) and figures (1,2) the significant effects of fertilization levels, stimulus levels and the overlap between them. The level of fertilization (F3) gave the highest total grain yield average reached 7.589 t ha\(^{-1}\), whereas, the level of fertilization (F2) gave the lowest average attained 5.256 t ha\(^{-1}\). The reason may be due to the positive effect of the fertilization level (F3) its ability to provide food supplies during the stages of plant growth and provide nutrients, thus increase the efficiency of the photosynthesis process and its positive effect on increasing the number of tillers per unit area as showed in the table (3). In addition to increasing the flag leaf area as in the table (2) and then increase the grain yield. This result agreed with [5]. The level of stimulation (G2) exceeding and showed a highest total grain yield average rating 7.344 t ha\(^{-1}\) while the level of stimulation (G1) gave the lowest average attained 5.556 t ha\(^{-1}\). The reason may be that gibberellin increased the efficiency of photosynthesis and activated other vital activities that take place in the plant cell (cell division and increase its elongation) and thus increased plant height table (1) flag leaf area table(2) number of tillers table(3) which was reflected positively in the total grain yield. This result agreed with [2]. Interaction treatment (F3G2) gave the highest total grain yield average reached 8.133 t ha\(^{-1}\) while the interaction treatment (F2G1) gave the lowest average attained 4.367 t ha\(^{-1}\).

**Table 6.** Total grain yield (t. ha\(^{-1}\)) under the influence of mineral and nano fertilization and stimulation of gibberellin.

| Treatment | F1  | F2  | F3  | Mean | LSD G |
|-----------|-----|-----|-----|------|-------|
| G1        | 5.400 | 4.367 | 6.900 | 5.556 |       |
| G2        | 7.600 | 6.300 | 8.133 | 7.344 | 0.165 |
| G3        | 6.567 | 5.100 | 7.733 | 6.467 |       |
| Mean      | 6.522 | 5.256 | 7.589 |      |       |
| LSD       |      |      |      | 0.165|       |

**Figure 1.** The effect of mineral fertilization levels on the studied traits.
Conclusions

The process of stimulation wheat seed at level (G2) with using of level fertilization (F3) they have a clear role in increasing some of the studied traits , which it increased the total grain yield of the Ibaa99 variety .

References

[1] Abdel Abbas, A.S. 2016. The effect of seed quantities, agricultural distances and levels of nitrogen fertilizer on growth and yield of oats Avena sativa L. Master Thesis Faculty of Agriculture Al-Muthanna University
[2] Hamza OM and AL-Taey DKA.2020. A study on the effect of glutamic acid and benzyl adenine application up on growth and yield parameters and active components of two Broccoli hybrids. Int. J. Agricult. Stat. Sci.. 16, Supplement 1: 1163-1167. DocID: https://connectjournals.com/03899.2020.16.1163
[3] Al-Mousawi, A. N.; Abbas, A. A.; Suzan, M. K.; Lina, Q. K.; and Fatima K. Kh. 2016. The effect of potassium nitrate on stimulating germination of two varieties of wheat Triticum aestivum L. Al- Furat Journal of Agricultural Sciences. The Third Agricultural Conference: 22 - 29.
[4] Al-Nuaimi, H.T. A. 2015. Effect of salinity of irrigation water and spraying with gibberellin and potassium on the growth and yield of wheat. PhD thesis. Field crops Faculty of Agriculture University of Baghdad
[5] Al-Saidan, Kh. J. Y.2019. Effect of fragmentation of mineral and nano fertilizers (N, P) and stages of addition to the scales of growth and yield of components for two varieties of Wheat (Triticum aestivum L.) PhD thesis.Faculty of Agriculture Al-Muthanna University.
[6] Al-Shammari,M.J.2018. Three genotypes response to yellow corn Zea mays L. To spray with levels of nanocomposite. Master Thesis Faculty of Agriculture Albasrah University.
[7] Jadoua,Kh.A.; and Al-Silawi, R. L. A.2012. Effect of seed stimulation on growth and yield of some rice varieties. Iraqi Journal of Agricultural Sciences. 43 (5) : 1 - 12.
[8] Al-Juthery HWA, Ali EHAM, Al-Ubori RN, Al-Shami QNM and AL-Taey DKA.2020.Role of foliar application of nano npk, micro fertilizers and yeast extract on growth and yield of wheat. Int. J. Agricult. Stat. Sci. Vol. 16, Supplement 1, : 1295-1300. DocID: https://connectjournals.com/03899.2020.16.1295