Effect of Cytokinin Levels on Some Varieties of Wheat on Yield, Growth and YIELD COMPONENTS

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Abstract

An experiment was conducted throughout winter 2020-2021 in the experimental field of the Department of Field Crops, Tikrit University to investigate the effect of spraying cytokinin on the growth and yield of wheat bread *Triticum aestivum* L. varieties. Randomized Complete Block Design (RCBD) was used with a split-plot system and three replications. Cytokinin concentrations were 0, 100, 200 that were sprayed on two dates; during the branching stage (ZGS: 22); during the al-Battan stage (ZGS:40). Ten varieties were used included Al-Rasheed, Ibaa 99, Sham 6, Baghdad, Bohouth 22, Adana 99, Bora Italian, Sulaymaniyah 2, Al Fayyad and Al Wafiya. Nnumber of days from planting to 50% of spikes, leaf area of the flag, grain yield and biological, and protein percentage and wet gluten percentage were measured. The ten-wheat cultivars showed a significant difference in growth, yield, and quality. The Fayyad was the earliest than the other cultivars by the number of days from emergence to 50% spikes, 104.33 days, and the highest of the number of spikes per area unit, 569.22 spikes. m-2. Rashid cultivar showed the highest average of flag leaf area, 67.22 cm², and the highest average number of grains per spike,100.88 grains. Also, it gave the highest average of grain yield, 496.77 g. m-2. Sulaymaniyah 2 cultivar was the highest in the weight of 1000 grains, 51.38 g. Spraying 200 ml. L-1 cytokinin indicated a significant difference for the most of traits such as flag leaf area, 53.56 cm², the number of grains in the 78.80 grains, biological yield 452.46 g. m-1, protein percentage, 15.02%.

Keywords: Wheat cultivars, Cytokinin, Flag leaf area, Protein.

1. Introduction

Bread wheat (*Triticum aestivum* L.), which belongs to the Poaceae family, is one of the most important strategic cereal crops in the world. The wheat crop is cultivated in large areas in the world compared to other crops to constitute about 32% of the cultivated area of all crops in the world [1], as the cultivated area is estimated at 219 million hectares, as it produced 771 million tons) of wheat grain, as Iraq’s production of wheat crop in In 2018, (2.2) million tons, and it is expected that the production of the crop will increase in 2019 with an estimated amount of (5.2) million tons, as it gave an expected increase of 81.8% [2]. The crop area planted in Iraq reached 147,888 hectares for the year 2016 and an average yield of 0.826 tons. ha-1 (31). Wheat grains are a food source for more than 50% of the world's population, as well as an important source of protein by a range of (20-6%) and also provide the human body with calories (25%) (18; 8). The global production of wheat should be increased by 50% to meet the needs of the world's population [3]. For this reason, the wheat breeder must focus on using the best modern programs in cultivating the wheat crop, and this leads to the improvement of qualitative and quantitative characteristics [4].

Phytohormones are the most important endogenous substances for moderating physiological and molecular responses, a critical requirement for plant survival. Phytohormones act at their site of synthesis or elsewhere in plants following their transport [5,6]. Cytokinin plays an important role in regulating the growth of the crop and employing vital activities inside the plant to increase the yield and its components due to its importance in activating cell division [7]. Recently, it was concluded that a group of local wheat cultivars in Iraq are characterized by low content of protein and gluten, which affects their ability to manufacture bread. Functional flour is highly dependent on gluten proteins [8]. Cytokinin significantly affects the physiological activities within the plant tissues through the regulatory role that it plays in increasing the vegetative growth area of leaves and stems, as it delays aging, increases flowering and fruit set and increases its size, and increases chlorophyll biosynthesis, cell division and elongation [9,10]. The quality characteristics and composition of wheat flour protein are affected by the genetic structure and environmental conditions, that is, the different varieties of wheat and the different environmental conditions produce different quality characteristics, and that the protein content and quality is an important criterion in dividing the different varieties of wheat because of its importance in determining the function of the final product [11], and because of the lack of studies on the use of cytokinin in Iraq on wheat, this study was conducted to determine the
best concentration of cytokinin concentrations that improved the growth and yield of wheat crop of quality and high protein, in addition to knowing the best variety of wheat.

2. Materials and Methods

A field experiment was carried out during the winter season 2020-2021 in the experimental field belonging to the Department of Field Crops - College of Agriculture - Tikrit University - to know the effect of spraying with cytokinin on the productive qualities of varieties of bread wheat. Ten random samples were taken from the field soil before planting to ensure the suitability of the soil for cultivation on a Depth of 0-30 cm for laboratory analysis and knowledge of its chemical and physical properties. Laboratory analyses were carried out in the laboratories of Tikrit University. Faculty of Agriculture. The soil section and the results of the analyses were as shown in table (1) below.

Table 1. Chemical and physical properties of the experimental soil before planting.

| Properties            | Value    | Unit               |
|-----------------------|----------|--------------------|
| pH                    | 7.2      |                    |
| Electrical conductivity| 1.681    | Des-siemens per meter |
| Organic Matter        | 0.97%    | g. Kg⁻¹ soil       |
| Lime                  | 25.6     | g. Kg⁻¹ soil       |
| Gypsum                | 15.05    | g. Kg⁻¹ soil       |
| Nitrogen              | 15.7     | mg. Kg⁻¹ soil      |
| Phosphorous           | 9.3      | mg. Kg⁻¹ soil      |
| Potassium             | 11.4     | mg. Kg⁻¹ soil      |
| Sodium                | 146      | mg. Kg⁻¹ soil      |
| Sand                  | 56.4     | g. Kg⁻¹ soil       |
| Silt                  | 29.6     | g. Kg⁻¹ soil       |
| Mud                   | 14       | g. Kg⁻¹ soil       |
| Tissue                | Sandy loam |                |

A randomized complete plot design (RCBD) was conducted based on a split-plot system and with three replications. The experimental land was prepared for cultivation the land was divided into three blocks, each block contains 30 experimental units with an area of 2 m², and the distance between the repetitions is 1 m. The experimental units included 4 lines with a length of 2 m and the distance between lines is 25 cm. A quantity of 160 kg. ha⁻¹ seeds were used. The field was fertilized with (DAP) at a rate of (100 kg. H⁻¹) and was added in one batch only when planting, and the experiment was also urea fertilizer (46% N) was used as a source of nitrogen at a level of (200 kg. H⁻¹) in two batches, the first at planting and the second at the beginning of the branching stage, as well as super fertilizer was added Triple phosphate (46% P₂O₅) at a rate of 100 kg P₂O₅ /ha. The seeds of wheat varieties were planted manually and on 11/20/2020, the harvesting was done manually for the crop when the plants reached the stage of full maturity. The growth regulator 6-Benzylaminopurine) was used (N-phenylnethyl-1H-purin-6-amine), the first spray was at a concentration of 100, and the second concentration was (1000 mg / 10 litres of water). The spraying process was conducted in the early morning, and the important stages of the vegetative growth of the plant were determined when spraying the foliar with growth regulators based on the scale [12].

Studied parameters

- Area of the flag leaf (cm²): The area of the flag leaf was calculated from the average of ten flag leaves of the main stems, which were randomly taken to each experimental unit.
- Number of grains/ spike-1: It was calculated manually as an average of the number of grains in ten spikes randomly taken from the harvested spikes to each experimental unit.
- Grain yield (tons H⁻¹): It was calculated the weight of grains to each experimental unit after harvesting.
- Biological yield (ton.h⁻¹): It represents the weight of the total dry matter of (heads and straw) as it was calculated based on the weight of the plants harvested to study the components of the yield and about the weight based on tons in hectares [13].
- Percentage of protein (%): The protein percentage was estimated using the Keldahel device for estimating total nitrogen to calculate the percentage of nitrogen and then the percentage of crude protein A.OAC (1980) is calculated using the following equation:

  \[
  \text{Protein percentage} = \text{nitrogen percentage} \times 5.7\%.
  \]
- The percentage of wet gluten (%): The percentage of gluten was calculated for the flour of wheat samples using the standard method AACC (1998) [14].
3. Results and Discussion

3.1. Area of the Leaves, cm²

The results of the data in Table (2) showed that there were significant differences between the varieties included in the study for the average area of the leaf, as the Al-Rasheed cultivar excelled by giving the highest average area of the leaf amounted to (67.22) cm², while the plants of the Italian cultivar Port Italian recorded the lowest average for the trait amounted to (38.44) cm², and the reason for the discrepancy in the area of the leaf between the varieties may be due to the difference like the genetic structure of the wheat variety and the extent to which it is affected by environmental factors. This was indicated by [15,16]. As for spraying with cytokinin, the results of Table (2) showed a significant increase in the characteristic of the area of the leaf when spraying cytokinin at the third concentration (200) mg / liter, it gave the highest average amounted to (53.56) cm², while the comparison treatment was the first concentration (Control) mg / liter, it gave the lowest average amounted to ((47.00) cm², and the reason may be due to the role of cytokinin in cell division and the softness of the cell wall and the ability of the cell itself to swell, which increases the plasticity of the cell wall and then the cell expansion and increase in size [17], and this result indicated by [18,19]. As for the interaction between the varieties and the concentrations of spraying with cytokinin, it had an evident effect in this trait, as the Al-Rasheed and the third spray with concentration (200) mg / liter achieved the highest value for the area of the leaf of the plant reached (70.33) cm², while Sulaymaniyah 2 cultivar with the third concentration (200) mg/L achieved the lowest value for the above characteristic which was 36.33 cm².

Table 2. The effect of cultivars and cytokinin spraying on wheat flag leaf area cm².

| Verities         | Cytokinin Concentrations | Mean  |
|------------------|--------------------------|-------|
|                  | 0 mg. L⁻¹ | 100 mg. L⁻¹ | 200 mg. L⁻¹ |
| Al Fayyad        | 39.33 po  | 47.33 lk     | 49.66 jk     | 41.77 g     |
| Sulaymaniyah 2   | 41.66 o   | 52.00 ji     | 36.33 q      | 44.88 f     |
| Baghdad1         | 44.33 n   | 46.66 lmn    | 39.00 p      | 62.22 b     |
| Ibaa 99          | 41.66 o   | 51.66 ji     | 40.00 po     | 48.66 e     |
| Bohouth 22       | 46.00 lmn  | 55.33 hg     | 49.66 jk     | 51.22 d     |
| Adana 99         | 47.00 lm   | 44.66 mn     | 54.66 h      | 49.77 e     |
| Al Wafiya        | 60.00 fe   | 51.00 j      | 57.66 fg     | 45.44 f     |
| Boro Italian     | 61.00 de   | 53.66 hi     | 63.33 dc     | 38.44 h     |
| Sham 6           | 65.66 bc   | 41.66 o      | 68.00 ba     | 54.00 c     |
| Al-Rasheed       | 46.66 lmn  | 45.00 lmn    | 70.33 a      | 67.22 a     |
| Concentration Mean | 47.00 c | 50.33 b       | 53.56 a      |

3.2. Number of grains Spike

It was found from Table (3) that there was a significant difference between the cultivars in the number of grains in the spike, as Al-Rasheed cultivar recorded the highest average number of grains in the spike, which amounted to (100.88) grains, which differed significantly from all the cultivars included in the study, while the variety Sham 6 gave the lowest average number of grains It reached 58.33 grains, and the reason for this difference between the varieties in this trait may be attributed to the role of cytokinin in cell division and the softness of the cell wall and the ability of the cell itself to swell, which increases the plasticity of the cell wall and then the cell expansion and increase in size [17], and this result indicated by [18,19]. As for spraying with cytokinin, the results of Table (3) showed a significant increase in the character of the number of grains in the spike when spraying cytokinin at the third concentration (200) mg/litre, which gave the highest average of (78.80) grains, while in the comparison treatment, the first concentration, Control ((0 mg/litre), recorded the lowest average of (72.90) grains, and the reason for the increase in the number of grains in the spike when treating the spray may be due to the increase in the length of the spike in addition to the increase in the characteristics of vegetative growth and chlorophyll content, which reflected positively On the trait, as the products of photosynthesis increased, which affected the number of grains in the spike, and this result is consistent with the findings of [20,21]. As for the interaction between the cultivars and the concentrations of cytokinin spraying, it had a significant effect in this trait, as Al-Rasheed cultivar achieved when spraying with cytokinin the
third concentration (200) mg/litre, the highest value for the trait amounted to (104.33) grains, while the Bohouth class 22 achieved when spraying with the third concentration ((200 mg/litre, the lowest value was (55.00) tablets.

| Varities          | Concentrations | Mean   |
|-------------------|----------------|--------|
| Al Fayyad         | 71.33 ln       | 91.66 d|
| Sulaymaniya 22    | 75.00 nk       | 70.66 e|
| Baghdad 1         | 77.00 ji       | 82.66 c|
| Ibbaa 99          | 68.33 no       | 87.00 b|
| Bohouth 22        | 70.33 nm       | 73.55 d|
| Adana 99          | 73.33 lk       | 64.66 f|
| Al Wafiya         | 78.33 i        | 88.11 b|
| Boro Italian      | 83.33 h        | 61.66 g|
| Sham 6            | 86.33 fg       | 58.33 h|
| Al-Rasheed        | 82.66 h        | 100.88 a|
| Concentration Mean| 72.90 c        | 78.80 a|

### Table 3. Effect of cultivars and spraying with cytokinin on the number of grains/spike

The results of Table (4) showed that the Al-Rasheed cultivar was significantly superior by giving the highest average grain yield amounted to (496.77 g/m²), while the Italian Borro cultivar achieved the lowest average for this trait amounting to 420.55 g/m². The reason for the superiority of some varieties in this trait may be due to the ability of some genetic varieties to benefit from the products of photosynthesis, which led to the variation in most of their traits, including the trait of grain yield. These results are consistent with researchers [22-25], who found significant differences between the varieties in grain yield. As for spraying with cytokinin, the results of Table (4) showed a significant increase in the weight of grain yield when spraying cytokinin at the third concentration (200 mg/litre, which gave the highest average of (452.46) g / m², and the comparison treatment (first concentration (Control 0)) mg/litre gave the lowest average amounted to (447.36) g / m², and that this increase in yield may be due to the increase in the area of the flag leaf, the components of the yield, the number of spikes m-2 and the number of grains per spike, which led to an increase in grain yield, this result was in line with the results of [26-28]. As for the interaction between cultivars and spraying cytokinin concentrations, it had a significant effect in this trait, as the Rashid cultivar achieved the concentration The third (200 mg / l and a.k.a The highest value reached (502.33) g/m², which did not differ significantly from Sham6 cultivar in the third concentration (200) mg/litre, which gave a value of (500.00) g / m², while the cultivar Bohouth 22 gave the lowest value in the third concentration (200) mg/litre It reached (412.66) g/m². Table (4) Effect of cultivars and spraying with cytokinin on grain yield (g/m²).
on for the difference between the varieties is due to their genetic nature and extent in physiological ability to form products of photosynthesis, this result is in line with the results of [29,30].

\[ \text{Table (6) showed that there was a significant effect of the varieties for this trait, as the Aba 99 variety outperformed significantly by giving it the highest average (15.72\%), while Bohouth 22 gave the lowest average (13.34\%), and the reason for the difference between the varieties is due to their genetic nature and extent in physiological ability to form products of photosynthesis, this result is in line with the results of [33,34], who found a significant difference between} \]
wheat cultivars in the protein content of their grains. As for spraying with cytokinin, the results of Table (6) showed a significant increase in The characteristic of the percentage of protein when spraying cytokinin at the third concentration (200) mg / liter gave the highest average of (15.02%), as for the comparison treatment, the first concentration (Control 0) mg / liter, it gave the lowest average of (14.56%) g_m², and the reason may be due to In increasing the ratio of protein to the role of cytokinin in increasing the speed of photosynthesis and its role in increasing the conversion of accumulated nitrogen to grains, as well as its important role in the metabolism of amino acids and then increasing proteins, this result is consistent with [35]. Cytokinin spray bag had a significant effect in this trait, as Sulaymaniyah 2 cultivar achieved when spraying with cytokinin the second concentration (100) mg / liter, the highest value of the character reached (51.86%) grain, while Baghdad 1 variety achieved when spraying with the second concentration ((100) mg / liter The lowest value was (13.13%).

Table 6. Effect of cultivars and spraying with cytokinin on the percentage of protein (%).

| Verities           | Concentrations |
|--------------------|----------------|
|                    | 0 mg. L⁻¹ | 100 mg. L⁻¹ | 200 mg. L⁻¹ | Mean  |
| Al Fayyad          | 37.93 f   | 37.96 f   | 42.63 a     | 38.36 c |
| Sulaymaniyah 2     | 38.46 e   | 38.13 f   | 32.53 o     | 35.92 f |
| Baghdad 1          | 38.70 e   | 39.40 d   | 32.93 n     | 32.40 i |
| Ibaa 99            | 35.66 l   | 39.73 c   | 33.13 n     | 37.87 d |
| Bohouth 22         | 35.96 k   | 39.86 c   | 36.06 k     | 39.66 b |
| Adana 99           | 36.13 kj  | 34.90 m   | 36.43 ih    | 35.34 g |
| Al Wafiya          | 32.13 p   | 35.50 l   | 36.36 h     | 42.38 a |
| Boro Italian       | 32.43 o   | 35.63 l   | 35.70 l     | 32.86 h |
| Sham 6             | 32.63 o   | 42.10 b   | 36.13 kj    | 36.37 e |
| Al-Rasheed         | 37.53 g   | 42.43 a   | 36.36 ij    | 36.06 f |

* Similar letters indicate no difference

3.6. Percentage of wet gluten %

The results of Table (7) showed that there was a significant effect of the varieties for this trait, as the Al-Wafiya variety outperformed by giving it the highest average for the trait amounted to (42.38%), while the Baghdad 1 variety gave the lowest average for this trait amounted to (32.40%). Perhaps the reason for the superiority of this variety is due to Variation of genotypes between the studied cultivars This result is consistent with [36], who found significant differences between wheat cultivars in the percentage of gluten in the grains. As for spraying with cytokinin, the results of Table (7) showed an increase significantly in the wet gluten ratio when spraying cytokinin at the third concentration (200) mg / liter, it gave the highest average of 36.98 % (gm_m², while the comparison treatment first concentration (Control 0)) mg / liter gave the lowest average of (36.39%) gm_m² The reason for this increase is attributed to the role of cytokinin, which increases the speed of plant photosynthesis and leads to an increase in protein, and this protein is of great importance due to its ability to give the dough the characteristics of viscoelastic, where the glutenin gives the elasticity and strength to the dough, while the claydin gives the viscoelastic character. The result was with [32]. As for the interaction between the cultivars and the concentrations of cytokinin spraying, it had a significant effect in this trait. When spraying with cytokinin, the second concentration (100) mg / liter of Al-Rashid cultivar achieved the highest value of the trait amounted to (42.43%) grain, while Mortality class when the control treatment (0 mg/L) achieved the lowest value (32.13%).
Table 7. Effect of spraying cytokinin and varieties on the percentage of wet gluten (%).

| Verities          | Concentrations | Mean |
|-------------------|----------------|------|
|                   | 0 mg. L⁻¹ | 100 mg. L⁻¹ | 200 mg. L⁻¹ |
| Al Fayyad        | 13.73 o    | 15.80 ba  | 15.60 bdc   | 14.06 g    |
| Sulaymaniyah 2   | 14.06 n    | 15.86 a   | 14.66 kl    | 14.75 e    |
| Baghdad1          | 14.40 m    | 13.13 q   | 14.96 ji    | 15.05 d    |
| Ibaa 99           | 14.40 m    | 13.40 p   | 15.26 hgf   | 15.30 c    |
| Bohouth 22        | 14.80 kj   | 13.50 p   | 14.80 kj    | 13.34 h    |
| Adana 99          | 15.06 hi   | 15.06 hi  | 15.06 hi    | 15.44 b    |
| Al Wafiya         | 14.76 kj   | 15.56 dc  | 15.10 hgi   | 15.30 c    |
| Boro Italian      | 15.10 hgi  | 15.70 bac | 14.63 kl    | 14.96 d    |
| Sham 6            | 15.30 egf  | 14.90 ji  | 14.30 m     | 14.98 d    |
| Al-Rasheed        | 15.50 edc  | 15.40 edf | 14.46 ml    | 14.46 f    |
| Concentration Mean| 14.56 c    | 14.84 b   | 15.02 a     |

* Similar letters indicate no difference

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