**Eastern Journal of Agricultural and Biological Sciences (EJABS)**
**ISSN: 2753-3247**
**Website: https://qabasjournals.com/index.php/ejabs**

# Effect of herbicides and irrigation methods on growth and yield traits of Bread wheat Crop (Triticum aestivum L.) and its companion weeds

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**ARTICLE INFO**

**Received**: Nov 1, 2023
**Accepted**: Dec 1, 2023
**Volume**: *3*
**Issue**: 3

**KEYWORDS**

**weeds, wheat varieties, herbicides, irrigation systems**

**ABSTRACT**

This experiment was conducted to study the effect of weed control herbicides accompanying the soft wheat crop under rainy and irrigated conditions in wheat fields for the 2022-2023 agricultural season and to study the extent of the impact of these factors on the characteristics of the crop, its components, and the weeds accompanying the crop. The experiment included three factors: The first factor was two irrigations systems, the second factor was two varieties of bread wheat and the third factor was three types of selective herbicides to weeds control in wheat fields according to RCBD design with a factorial experiment system with three replications. The results indicated there was effect of herbicides and irrigations systems on all the traits of the varieties had effect as the Babel variety outperformed the Baghdad variety in (plant height, leaf area, Number of spikes, weight of 1000 grains, and grain yield. As for the irrigations system, it was superior to the demotic system in terms of (plant height, leaf area, number of spikes, weight of 1000 grains, and grain yield). As for herbicides, The herbicide Tarzek was superior to the herbicide Axial and the comparison treatment in terms of G.y, weight of 1000 grains, number of branches, and leaf area, did not differ significantly with Prince herbicide. As for the weed traits, Prince herbicide was superior to Tarzek and Axial herbicides have effect on all characteristics, except for the weight of 1000 grains, which was significant.

## 1. Introduction

Bread wheat (Triticum aestivum L.) is considered the primary source on which people depend for food in most countries of the world, especially Iraq. Due to the economic importance of this crop globally and locally, it receives great interest from those in charge of agriculture from the academic and applied agricultural sides for the purpose of increasing production and advancement of the agricultural situation in general, and wheat cultivation, in particular, is considered yellow gold because of the high nutritional value it contains, as protein represents 12-17%, starch 75%, and some vitamins, fats, and salts (Khalil et al. 2015). Despite the importance that the crop occupies first place, the amount of local production still does not cover the internal consumption needs of the people, and because of the obstacles that confront the production of the wheat crop, such as the presence of weeds that compete with the crop for space, moisture, and nutrients, as it causes a loss of grain yield that may reach approximately 40 - 70%. Recently, due to the lack of use of herbicides in the quantities recommended by companies, resistance of the weeds to herbicides has appeared ( Suhad, 2016 , Andruszczak, S. 2017) as well as the lack of rain due to climate change. Therefore, researchers must use the best methods in developing chemical herbicides to eliminate weeds and choose the best varieties, whether newly introduced or bred varieties that compete with the weeds. with high productivity, most researchers resorted to using safe selective herbicides recently introduced to the commercial market that had previously been developed by manufacturers such as Axial herbicide, Tarzek herbicide, Prince, and others, which is the least expensive method, least effort, and does not require large capabilities, testing, and then recommending it based on the data that They are obtained from scientific experiments, within the appropriate timing, and at the concentrations recommended by the companies with high accuracy (Al-Obadui. et al 2020, Abdulateef et al 2023) The study aims to evaluate the performance of herbicides in reducing the spread of weeds in wheat fields, especially local varieties, and within rain-fed and irrigated conditions, and their effect on the characteristics of the crop.

## 2. Materials and Methods

### *2.1. Location of experiment*

This experiment was conducted to study the effect of weed control herbicides associated with the soft wheat crop under rain-fed and irrigated conditions in wheat fields in Nineveh Governorate for the 2022-2023 agricultural season in the north of the city of Mosul in the Wana district, located within the rain line, for two types of bread wheat that are most common among farmers, and to study the extent of the effect of these. Factors on the characteristics of the crop, its components, and the weeds accompanying the crop. The experiment included three factors, two irrigations systems (rainy, irrigations), two varieties of bread wheat (Baghdad, Babel), and three types of optional herbicides to combat weeds in wheat fields (Axial, Prince, Tarzek)

### *2.2. Design for experiment and analysis*

According to a complete randomized block design. Using a factorial experimental system with three replicates, the data was analyzed with Program Genstat.

### *2.3. Agriculture and planting time and methods*

the experimental land was prepared by plowing it perpendicularly with a disc plow and smoothing it with a rake. Planting was done at a seed rate of 30 kg per dunum in the form of lines with a distance of 20 cm between one line and another on 12/5/2022. The ground was fertilized according to the recommended proportions. According to the Iraqi Ministry of Agriculture, it requires 50 kg of fertilizer per dunum when planting, and 30 kg of urea fertilizer per dunum when flowering.

### *2.4. The factor applied in experiment: included three factors*:

a: Irrigation systems are of two types, the first is irrigation and the second is rainy.

b: Two types of soft bread wheat (Baghdad, Babel).

C: Three types of selective herbicides, in addition to treatment without herbicide.

**Table 1. Commercial names and chemical composition of the herbicide used in the study**

| Commercials name | Active substance | Application rates | Date of Applications | Weeds Sensitive for herbicides |
|---|---|---|---|---|
| Axial | Pinoxaden 50 g/l | 300 ml/d | Post emergence | Narrow weeds |
| Prince | Sulfousuron%75 g /kg | 50 gm/d | Post emergence | Narrow and broade weeds |
| Tarzek WG | Perxolm 250g/kg & heloxefen methyl 69.5 g/kg | 22.5gm/d | Post emergence | Narrow and broade weeds |

### *2.5. The following characteristics were studied:*

1. *Characteristics of the weed*: A sample of the weed of an area of 1 m2 was taken 45 days after the date of treatment with the herbicide, and the following characteristics were studied:

A. Density of narrow-leaved weeds B: Dry mass of shoots of narrow-leaved weeds C: Density of broad-leaved weeds D: Dry mass of shoots of broad-leaved weeds

2. *Growth characteristics*: 10 random plants were taken from the middle lines and the following characteristics were studied:

A: Plant height B: Flag leaf area C: Chlorophyll content in the leaf Spad/Spad device

3. *Characteristics, yield, and its components*: An area of 1m2 was harvested and the following characteristics were studied: A: Number of spike (number of spikes) B: Weight of 1000 grains C: Grain yield/m2.

## 3. Results and Discussion

### The density of the narrow leaves weeds

The results in (Table 2) indicated there was effect of irrigations systems and herbicides in reducing weed density, as all herbicides outperformed the comparison treatment, and the Prince herbicide gave the lowest number of weeds, amounting to 1.83 weeds/m2, and it did not differ significantly with the other two herbicides (Tarzek and Axial), and the reason for this is due to The efficiency of the herbicide in eliminating narrow-leaved weeds(Abdulkerim et al 2015 , Abdulateef et al 2023), especially wild barley. As for irrigations systems, the rainy system was better in terms of giving the lowest average number of weeds, amounting to 2.96 weeds/m2. The reason for this is the lack of vegetation, unlike the irrigations system, which provides more moisture than the rainy- system. It stimulates weed growth, but the varieties did not show significant differences in the number of weeds. As for the interactions between the factors, the binary interaction between herbicides and irrigations systems showed effect on the density of the weed. As for the other interactions and the triple interaction of the study factors (irrigations systems, herbicides, and varieties) did not show any significant effect on Weed density.

### Dry mass of narrow-leaved weeds

The results (Table 2) indicate there is effect of irrigations systems and herbicides on the dry mass of the narrow-leaved weed, as the demotic system was effect to the irrigations system by giving the lowest average mass of the narrow-leaved weed, which amounted to 11.4 g/m2, as the herbicides led to reducing the presence of the weed in the field by giving the lowest average mass. Dry for the narrow weeds, as the herbicide Prince was significantly superior to the comparison treatment with the lowest average weight weeds 7.2 g/m2, and it did not differ significantly with the herbicides Tarzek and Axial, due to the high efficiency of the herbicide in eliminating the narrow weeds associated with the wheat crop (Abdulkerim et al 2015, Abdulateef et al 2023). As for the varieties, it did not appear to have any significant effect on the weed density. As for the double and triple interaction between the factors, there was no significant effect on the mass of the narrow-leaved weed, with the exception of the interaction between irrigations systems and herbicides, which had a significant effect in reducing the dry mass of the vegetative mass of the narrow-leaved weed.

### Density of broad-leaved weed

The results in (Table 2) indicated there was a significantly significant effect of irrigations systems and herbicides in reducing the density of broad-leaved weeds, as the rainy system was effect to the irrigations system by giving the lowest average number of broad-leaved weed, amounting to 3.33 weeds/$m^2$, and the Prince herbicide was significantly superior to the comparison treatment by giving less The average density of the broad weeds reached 2.75 weeds/$m^2$ and did not differ effect with the herbicides Axial and Tarzek ( Al-Khazali et al 2020 ). This is due to the efficiency of the herbicides in eliminating the weeds and reducing their presence in the field. As for the varieties, they did not have any effect in reducing the number of weeds. As for the double interactions and the triple interaction of the experimental factors, there is no significant effect on the density of broadleaf weed.

### Dry mass of foliage of broad-leaved weed

The results in (Table 2) indicate there is effect of irrigations systems and herbicides on the mass of the broad-leaved weed, as the demolition system was significantly superior to the irrigations system by giving the lowest average weight for the broad-leaved weed, amounting to 74.2 g/$m^2$. As for herbicides, the Axial herbicide and the Prince herbicide were significantly superior to the Tarzek herbicide ( Al-Khazali et al 2020 ) . The comparison treatment gave the lowest average weight of 52.9 g/$m^2$, and the Tarzek herbicide was significantly superior to the comparison treatment by giving an average of 73.6 g/$m^2$, while the average weight of the weed in the comparison treatment was 181.7 g/$m^2$. This decrease is due to the efficiency of the herbicides used in the experiment in eliminating the weeds. As for the binary interactions, the interaction of varieties and herbicides showed a significant effect in reducing the dry mass of the broad-leaved weed, and the other interactions between the factors did not show any significant effect in reducing the dry cannibalization of the weed. Likewise, the triple interaction had no effect on this trait.

**Plant height**

The results in (Table 2) showed there was a significant effect of the three experimental factors (irrigations systems, varieties, and herbicides) on the average plant height, where the irrigations system was effect superior to the demo system by achieving the high average plant height of 96.03 cm, while the demo system gave a plant height of 77.56 cm. Due to the abundance of water, which led to an increase in the plant growth rate, unlike plants in the rainy system. As for the varieties, the Babel variety was significantly superior to the Baghdad variety by achieving the high average plant height of 91.38 cm. The reason for this is due to the variety's efficiency in growth and the rapid formation of the vegetative system. Regarding herbicides, no significant differences appeared between herbicides in increasing plant height due to the lack of competition between weed plants and crop plants due to the decrease in the density of weeds, whether narrow or broad-leaved, due to the effect of herbicides. This is the opposite of what happened in the comparison treatment (Sultan et al 2016, Mwendwa et al 2020), where the presence of weeds led to an increase in the intensity of competition between crop plants. The interaction between irrigations systems and varieties, as well as the interaction between irrigations systems and herbicides, had a significant effect in increasing plant height, but the interaction between varieties and herbicides did not show any effect on the character of plant height. As for the three-way interaction between the experimental factors, there was no effect on this trait.

**Flag leaf area**

The results in (Table 3) indicated there was a significant effect of the three experimental factors on increasing the leaf area, as the irrigations system was significantly superior to the rainy system by giving the high average leaf area of 35.56 cm, while the rainy system gave 32.41 cm, due to the availability of sufficient moisture for the plant to grow properly. Ideal and the formation of a good vegetative mass, which led to an increase in leaf area. As for the varieties, the Babel variety was effect superior to the Baghdad variety, as it gave the high 35.32 cm, while the Baghdad variety gave a leaf area of 32.56 cm. The reason is due to the variety's efficiency in growth and the formation of an ideal vegetative mass (Razzaq, Haidar. 2017, Suhad 2016). As for herbicides (Prince, Tarzek, and Axial herbicide) were effect superior to the comparison treatment by giving the high average leaf area of 35.32, 35.91, and 34.71 cm, respectively, and did not differ significantly between them. The reason for this is due to the efficiency of the herbicides in eliminating the weeds (Table 2), which led to the ideal growth of the plant and the formation of a good vegetative system, as for interactions between factors, the interaction between irrigations systems and varieties showed effect in increasing the leaf area of the flag leaf. As for the other binary interactions and the triple interaction, no significant effect was shown in increasing the area of the flag leaf.

**Chlorophyll content in leaf/Spad**

The results (Table 3) indicate that there is a significant effect of the study factors on the chlorophyll content of the leaf, as the rainy system was effect superior to the irrigations system by giving the high average chlorophyll content of 49.06 Spad. The reason for this is the lack of leaf area compared to the leaf area in the irrigations system. As for the varieties, the variety was superior. The Baghdad variety was significantly superior to the Babel variety, as it gave the high average chlorophyll content of 50.18 Spad, while the Babel variety gave an average of 47.40 Spad (Table 2). As for herbicides, the herbicide Axial was significantly superior to the Prince and Tarzek herbicides, and the comparison treatment gave the high average chlorophyll content of 49.50 Spad. The Tarzek and Prince herbicides did not differ significantly in the all treatment. As for interactions between factors, the bilateral interaction between irrigations systems and herbicides and the interaction between varieties and herbicides showed a significant effect in increasing the chlorophyll content of the leaf, while the interaction between irrigations systems and varieties and the triple interaction of the study factors did not show any significant effect in Adjective (Algaffar 2014).

**Number of spikes**

The results (Table 3) indicated there was a significant effect on the number of branches (number of spikes) for the three experimental factors, as the irrigations system was effect superior to the rainy system by giving the high average number of correct branches (bearing spike) of 129.04 spike, while the rainy system gave 120.17 spike. As for the varieties, it was superior. The Babel variety was significantly superior to the Baghdad variety by giving the high average number of activities, amounting to 132.21 spike. The reason is due to the efficiency of the variety for high productivity compared to the Baghdad variety, which had an average number of activities of 117.00 spikes. As for herbicides, the herbicide Tarzek was significantly superior to the

Prince and Axial herbicides, and the comparison treatment gave the high average number. The levels reached 136.67 spike (Sultan et al 2016, Mwendwa et al 2020), while the herbicides Prince and Axial were effect superior to the all treatment and did not differ significantly between them due to the efficiency of the herbicides in limiting the spread of weeds and giving a good opportunity for the crop to grow optimally and form a high number of branches. As for the bilateral interactions, the dual interaction of the varieties with the herbicides showed It had a significant effect in increasing the number of correct segments, but the other interferences and the triple interference did not appear to have a significant effect in increasing the number of segments.

**Weight of 1000 Grains**

The results in (Table 3) indicate there is a significant effect of irrigations systems, varieties, and herbicides on the weight of 1000 grains, as the irrigations system was effect superior to the rainy system by giving the high average weight of 1000 grains, which amounted to 36.26 grams, while it reached 32.99 grams in the rainy system. The reason is due to the availability of appropriate moisture for the growth of the crop. Ideally, it led to an increase in the efficiency of metabolism and thus an increase in grain fullness. As for the varieties, the Babel variety outperformed the Baghdad variety, significantly, by giving the high average weight of 1,000 seeds, amounting to 35.86 grams. As for herbicides, the Tarzek and Prince herbicides were significantly to the Axial herbicide, and the comparison treatment gave the high average weight. 1000 tablets reached 36.30 and 36.26 grams, respectively, while the Axil herbicide was superior to the all treatment, and the two herbicides Tarzek and Prince did not differ significantly between them (Choudhary et al 2021, Abdulateef et al 2023). The reason is due to the efficiency of the herbicides in reducing the presence of weeds in the field (Table 2), which led to an increase in the efficiency of the plant in growth, which pushed the plant to Increase the rate of photosynthesis and increase grain yield. As for the bilateral interaction, the results (Table 3) showed a significant effect of the interaction between irrigations systems and herbicides and the interaction between varieties and herbicides in increasing the average weight of 1000 grains, while the interaction between the irrigations system and varieties did not show any significant effect. The triple interaction between irrigations systems, varieties, and herbicides showed a significant effect on increasing the weight of 1000 seeds.

**Grain yield**

The results (Table 3) indicated there was a significant effect of the three study factors on increasing the grain yield, as the irrigations system was effect superior to the rainy system by giving the high average grain yield of 338.2 grams, and the Babel variety was significantly superior to the Baghdad variety with an average yield of 322.3 grams, while the Baghdad variety gave a higher yield. It reached 306.1 g. (Abdulkerim et al 2015, Abdulateef et al 2023) As for herbicides, the Tarzek and Axial herbicides were significantly superior to the Prince herbicide and the comparison treatment by giving the high average grain yield of 347.0 and 336.3 grams. The Prince herbicide was also significantly superior to the comparison treatment. This increase in the amount of yield comes from an increase in the number of splits, an increase in grain yield (Han 2014, Rawia et al 2022, and leaf efficiency. In the plant in the process of photosynthesis, increasing the efficiency of plant growth, increasing grain yield, and increasing the final yield as a result of weed resistance and the use of the irrigations system in addition to the efficiency of the variety. As for the interaction between the experimental factors, the interaction between irrigations systems and herbicides showed a significant effect in increasing the yield. As for the other binary interactions, the triple interaction did not show any significant effects in increasing grain yield.

**Table. 3 Effect of experiment factors on the studied qualities of the agricultural season 2022 - 2023**

| System irrigations | No .narrow weeds $m^2$ | Dry W. of narrow weed $.gm.m^{-2}$ | No. broade weeds $m^2$ | Dry W. of broade weed $.gm.m^{-2}$ | High of plant cm |
|---|---|---|---|---|---|
| Irrigations | 6.38 | 29.6 | 6.33 | 109.1 | 96.03 |
| Rainy | 2.96 | 11.4 | 3.33 | 74.2 | 77.65 |
| Test F | 0.001 | 0.001 | 0.001 | 0.007 | 001 |
| L.S.D | 1.393 | 5.69 | 1.373 | 11.96 | 1.056 |
| Varieties | | | | | |
| Bagdad | 4.38 | 18.4 | 4.54 | 86.4 | 82.30 |

| | | | | | |
|---|---|---|---|---|---|
| Babel | 4.96 | 22.6 | 5.12 | 97.0 | 91.38 |
| Test F | N.S | N.S | N.S | N.S | 001 |
| L.S.D | N.S | N.S | N.S | N.S | 1.056 |
| Weed control | | | | | |
| Axial | 2.33 | 9.4 | 3.67 | 51.9 | 84.42 |
| Prince | 1.83 | 7.2 | 2.75 | 59.5 | 85.54 |
| Tarzek WG | 2.83 | 10.0 | 3.42 | 73.6 | 85.15 |
| Control | 11.67 | 55.4 | 9.50 | 181.7 | 92.25 |
| Test F | 0.001 | 0.001 | 001 | 0.001 | 001 |
| L.S.D | 1.970 | 8.05 | 1.941 | 16.91 | 1.493 |
| Interaction | | | | | |
| Irrg. × Vari. | N.S | N.S | N.S | N.S | 0.022 |
| Irrg. × herb. | 0.006 | 0.001 | N.S | N.S | 0.024 |
| Vari × herb. | N.S | N.S | N.S | 0.088 | N.S |
| Irrg.× Vari.×herb. | N.S | N.S | N.S | N.S | N.S |

**Table. 3 Effect of experiment factors on the studied qualities of the agricultural season 2022 - 2023**

| **System irrigations** | **Leaf area cm** | **Chlorophyll content Spad** | **No. of spike** | **W. Grin 1000 gm** | **G. Y. gm/m$^2$** |
|---|---|---|---|---|---|
| Irrigations | 35.56 | 48.52 | 129.04 | 36.26 | 338.2 |
| Rainy | 32.41 | 49.06 | 120.17 | 32.99 | 290.2 |
| Test F | 0.001 | 0.005 | 0.001 | 0.001 | 0.001 |
| L.S.D | 0.500 | 0.457 | 3.052 | 0.386 | 10.56 |
| **Varieties** | | | | | |
| Bagdad | 32.65 | 50.18 | 117.00 | 33.40 | 306.1 |
| Babel | 35.32 | 47.40 | 132.21 | 35.86 | 322.3 |
| Test F | 0.001 | 0.020 | 0.001 | 0.001 | 0.004 |
| L.S.D | 0.500 | 0.457 | 4.316 | 0.386 | 10.56 |
| **Weed control** | | | | | |
| Axial | 34.71 | 49.50 | 129.42 | 35.10 | 336.3 |
| Prince | 35.32 | 48.84 | 129.25 | 36.26 | 314.4 |
| Tarzek WG | 35.19 | 48.41 | 136.67 | 36.30 | 347.0 |
| Control | 30.72 | 48.41 | 103.08 | 30.84 | 259.2 |
| Test F | 0.001 | 0.005 | 0.001 | 0.001 | 0.001 |
| L.S.D | 0.707 | 0.647 | 3.052 | 0.546 | 14.94 |
| **Interaction** | | | | | |
| Irrg. × Vari. | 0.017 | N.S | N.S | N.S | N.S |
| Irrg. × her. | N.S | 0.023 | N.S | 0.045 | 0.016 |
| Vari × her. | N.S | 0.001 | 0.014 | 0.008 | N.S |
| Irrg.×Vari ×her. | N.S | N.S | N.S | 0.052 | N.S |

## 5. Conclusion

The application of factor in study was significant effect of herbicides and irrigations systems on all the traits of the varieties. There was no significant effect on the traits of the number of narrow and broad weeds and their dry weight. As for the other traits, the varieties had effect, as the Babel variety out performed the Baghdad variety in (plant height, leaf area, Number of spikes, weight of 1000 grains, and grain yield. As for the irrigations system, it was superior to the demotic system in terms of (plant height, leaf area, number of spikes, weight of 1000 grains, and grain yield). As for herbicides, the herbicide Tarzek was superior to the herbicide Axial and the comparison treatment in terms of Grain yield, weight of 1000 grains, number of branches, and leaf area, did not differ significantly with Prince herbicide. As for the weed traits, Prince herbicide was superior to Tarzek and Axial herbicides. As for the binary interactions, they did not have a significant effect on most of the traits studied.

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