

A Comparative Study Between Pre-Mixed Herbicides and Tank-Mixed Herbicides and Their Effects on the Efficiency of Foliar Fertilizers in Wheat Yield and Associated Weeds

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ABSTRACT

The field experiment was carried out during the 2024–2025 winter season in agricultural fields of Hamam Al-Alil district, Nineveh Governorate, Iraq, at two locations: Kabar Al-Abd village 30 km southeast of the city center) and Al-Khufsan village 41 km southeast of Mosul). The experiment was conducted according to the Strip-Block system By designing a (RCBD) with three iterations. with three replicates. Two factors were used in the experiment. The first is fertilization, which includes: F1: control without fertilizer, F2: foliar NPK (18, 46, 0) 50% + 50% Disper mixture, F3: foliar NPK (18, 46, 0) 50% + 50% Disper mixture, F4: foliar NPK (20, 20, 20) 50% + 50% Disper mixture, F5: foliar NPK (20, 20, 20) 50% + 50% Disper mixture, and F6: soil fertilizer NPK (18, 46, 0). The second factor is herbicides, which include: three treatments: Control, mix (Totic+U46), and Discipline OD. The traits were studied: Number of N.W. weed.m⁻², Number of B.W. weed.m⁻², Total Weed Number weed.m⁻², Dry weight N.W. g.m⁻², Dry weight B.W. g.m⁻², Total Dry weight weeds g.m⁻², Number of spike Spike.m⁻², Weight 1000-Grain g and Grain Yield Kg ha⁻¹.

The results showed a significant superiority of treatment T6 in combination with the herbicide MIX, recording the highest value of the trait, reaching (342.67 spikes.m²) with an increase percentage of (36.7%). In Al-Khufsan site, it reached (366.43 spikes.m²) with an increase percentage of (16.73%).The results of the interaction between fertilizers and herbicides at Kabar Al-Abd site demonstrated a significant superiority of T6 in combination with both herbicides (MIX and Discipline OD), recording the highest values of the Grain Yield, reaching (322.36 and 324.27 g.m²) with increase percentages of (67.67 and 48.11%), respectively, compared to the control. At Al-Khufsan site, the values reached (361.87 and 356.85 g.m²) with increase percentages of (35.12 and 34.54%), respectively. These results confirm the high efficiency of the integration between fertilization and herbicide application in enhancing total yield components and improving weed control.

Keywords: Wheat, Herbicides, Foliar Fertilization, Weed, Discipline OD, 2.4-D.

Introduction

Bread wheat (*Triticum aestivum* L.) is considered one of the most important and prominent staple cereal crops worldwide, playing a major role in strengthening global food security and ensuring human nutrition. Wheat represents the primary

food source for more than 40% of the world's population [1].

Recent statistical data issued by the Food and Agriculture Organization [2] indicate that global wheat production has reached record levels of approximately 804.9 million tons, reflecting a positive

ISSN 2072-3857

technological and agricultural response to escalating climatic and environmental challenges. However, this increase in production is accompanied by a continuous rise in global consumption rates, which reached 805.4 million tons, indicating a very narrow gap between supply and demand.

The cultivated area of wheat for the 2024 winter season was estimated at approximately (8.177) thousand dunums, while the harvested area for the same season reached (8.119) thousand dunums, representing (99.3%) of the total cultivated area. The total production was estimated at (5.234) thousand tons, showing an increase of (23.2%) compared to the previous year's production, which was estimated at (4.248) thousand tons. Nineveh Governorate ranked first in terms of production, estimated at (1.394) thousand tons, accounting for (26.6%) of the total production [3].

Wheat yield and grain quality primarily depend on the supply of nitrogen, phosphorus, and potassium (NPK). Phosphorus is often the limiting element for productivity. Foliar fertilization with NPK is used because nutrients applied to the foliage can overcome soil-related constraints, rapidly correct nutrient deficiencies during the growing season, and improve yield and nutrient uptake when applied at critical growth stages such as tillering and stem elongation [4]. Fertilizer formulations characterized by relatively high phosphorus content within NPK compounds, or those applied as specialized foliar phosphorus sources, have gained particular attention [5]. Specifically, spraying high-phosphorus NPK formulations during critical growth stages can enhance grain yield and grain phosphorus concentration compared with

conventional fertilization alone, indicating their potential as a practical tool to improve wheat nutrition under phosphorus-deficient conditions [6].

Weeds are considered among the most important biotic factors limiting the efficiency and sustainability of agricultural production systems worldwide. They are defined as plants that grow in an inappropriate temporal and spatial context and compete with economic crops for essential resources such as water, nutrients, and light, resulting in reduced productivity and lower crop quality. The impact of weeds is not limited to direct competition; their damage also extends to the release of inhibitory chemical compounds affecting neighboring plants, a phenomenon known as allelopathy, which can negatively influence crop germination and growth and exacerbate yield losses [7].

Chemical control using herbicides represents a fundamental component of integrated management strategies due to their rapid action and high efficiency in controlling large agricultural areas with minimal human effort. These herbicides operate through complex physiological mechanisms, including inhibition of photosynthesis, interference with cell division, and disruption of protein synthesis within weed plants. With the increasing orientation toward sustainable agriculture, recent research has focused on the use of low-toxicity and highly selective herbicides capable of eliminating target weeds without causing physiological damage to wheat crops, while also minimizing residual effects in the soil [8].

Research Objectives:

1. To evaluate the efficiency of different types of foliar fertilization and spraying timings, and to determine the most effective among them.
2. To evaluate three types of herbicides in order to identify the

most efficient one for controlling weeds growing in wheat fields.

3. To determine the best treatment combination among fertilization type, application timing, and herbicide that results in the lowest weed density and the greatest improvement in wheat yield.

MATERIALS AND METHODS

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Experimental Sites:

The field experiment was carried out during the 2024–2025 winter season in agricultural fields of Hamam Al-Alil district, Nineveh Governorate, Iraq, at two locations: Kabar Al-Abd village 30 km southeast of the city center) and Al-Khufsan village 41 km southeast of Mosul).

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Field Preparation:

The field was prepared by two perpendicular moldboard plowing operations followed by disc harrow pulverization; wheat cultivar Nazar was hand-sown on December 2, 2024, and harvested on May 28, 2025.

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Experimental layout:

The experiment was conducted according to the Strip-Block system and a Randomized Complete Block Design (R.C.B.D.) with three replicates. The main Blocks included crop varieties, secondary plots included fertilization treatments, and sub- Blocks included chemical herbicides for weed control. The area of each experimental unit was $2 \times 2 \text{ m}^2$.

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Experience Factors

1. Fertilization treatments include:

F1 Comparison without Fertilizer, F2 Foliar Fertilizer NPK (N:18, P:46, K:0) 50% + 50% Disper mix, F3^E Foliar Fertilizer NPK (N:18, P:46, K:0) 50% + 50% Disper mix, F4 Foliar Fertilizer NPK (N:20, P:20, K:20) 50% + 50% Disper mix, F5 Foliar Fertilizer NPK (N:20, P:20, K:20) 50% + 50% Disper mix and F6 Soil Fertilizer NPK (N:18, P:46, K:0). *Mix Disper fertilizer is a mixture of (Root, Chlorophyll, Complex), add the foliar fertilizer NPK (N:18, P:46, K:0) at a concentration of 5 liters/400 liters and NPK (N:15, P:15, K:15) at a concentration of 1 liter/400 liters in one application on (15/2/2025), and in two applications, the first on 25/12/2024 and the second on 5/2/2025.

* Foliar fertilizer NPK (N:18, P:46, K:0) at a concentration of 5 liters/400 liters and NPK (N:15, P:15, K:15) at a concentration of 1 liter/400 liters should be added in one application on February 15, 2025, and in two applications: the first on December 25, 2024, and the second on February 5, 2024.

2. Second Factor, Herbicides include:

three herbicides' treatments were used as follows: Control (without herbicides), mix (Totic+U46) and Discipline OD.

*Herbicides were added on 15/2/2025.

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Table (1) Composition of Foliar Fertilizers.

DISPER Complex SD		DISPER Root GS	
Iron (Fe).	3.0%, chelated with EDDHSA	Total Nitrogen (N)	20%
Manganese (Mn)	3.0%, chelated with EDTA	Ammoniacal Nitrogen	3.9%
Zinc (Zn)	5.0%, chelated with EDTA	Nitrate Nitrogen	5.8%
Magnesium (MgO)	1.0%, chelated with EDTA	Urea Nitrogen	10.3%
Copper (Cu)	3.0%, chelated with EDTA	Total Phosphate (P2O5)	20%
Boron (B)	0.7%	Total Potassium (K2O)	20%
Molybdenum (Mo)	0.3%	Trace Elements (EDTA):	Ppm
recommended for its application	150-300 g/L	Boron (B)	200
DISPER Complex SD		Chelated Copper	500
Free aminoacids	38,0%	Chelated Iron	1000
Polysaccharides	16,7%	Chelated Manganese	500
Vitamins	3,90%	Chelated Zinc	500
Humic extract	14,0%	Molybdenum	5
Phosphorous (P2O5)	10,0%	recommended for its application	0.3-0.5 g/L
Calcium (CaO EDTA chelated)	1,5%		
recommended for its application	50-80 g/100L		

Table (2) illustrates the commercial name, active ingredient, and recommended usage rate for herbicides.

Application Rate	Chemical composition of herbicides	Herbicides
1.25 L h⁻¹	Di flufenican 5% w.v +Mesosulfuron Methyl 0.75% w.v +Iodosulfuron-Methyl 0.25% w.v +Mefenpyer- Diethyl 2.25% w.v	Discipline OD
600 cm³ h⁻¹ + 0.75-1 L h⁻¹	Clodinafop propargyl 20% + Cloquintocet mexyl 80% +2.4 D 35% + MCPA 30%	Mix (Totic+U46)

• **Measured Traits**
 The following traits were studied: Number of Narrow-Leaved weeds (N.L.W.) Plant m⁻², Number of Broad-leaved weeds (B.L.W.) Plant m⁻², Total Weed Number Plant m⁻², Dry weight Narrow-Leaved

weeds (N.L.W.) g m⁻², Dry weight Broad-leaved weeds (B.L.W.) g m⁻², Total Dry weight weeds g m⁻², Number of spike Spike.m-2, Weight 1000-Grain g and Grain Yield Kg ha⁻¹.

• **Statistical Analysis:**

The field data obtained from the studied traits were statistically analyzed according to a factorial experiment arranged in a Strip-Plot system within Design (RCBD) with three replications. Mean comparisons

3. Results and Discussion

3.1. Number of (N.L.W.) Plant m⁻².

Findings presented in Table (3) regarding the effect of fertilizers on the trait of narrow-leaved weed density at Kabar Al-Abd site indicated the superiority of treatment T4 over the other treatments, recording the lowest weed density (3.00 Plant m⁻²), with a reduction percentage of (133.33%) compared with the control treatment T1, which recorded the highest value of the trait (7.00 Plant m⁻²).

At Al-Khufsan site, treatment T4 also showed significant superiority over the other treatments, recording the lowest value of the trait (3.76 Plant m⁻²), with a reduction percentage of (134.04%) compared with the control treatment T1, which recorded the highest value (8.80 Plant m⁻²). This may be attributed to the fact that soil-applied fertilizers are more readily utilized by weeds due to their root systems being more efficient in exploiting soil nutrients, whereas the crop shoot system is more efficient in absorbing foliar-applied fertilizers [10].

The results presented in Table (4) regarding the effect of herbicide treatments at Kabar Al-Abd site indicated a significant superiority of both herbicide treatments (MIX and Discipline OD), which recorded the lowest values of the trait, reaching (3.00 and 3.06 Plant m⁻²), with efficiency percentages of (52.22% and 51.27%), respectively, compared with the control treatment, which recorded the lowest value of the trait (6.28 Plant m⁻²). At Al-Khufsan site, the same treatments also showed

were performed using The Least Significant Difference Test (L.S.D) following the procedure described [9]. Statistical analyses were conducted using the Statistical Analysis System (SAS).

superiority, recording the lowest values of the trait (3.67 and 3.81 Plant m⁻²), with treatment efficiency percentages of (53.00% and 51.21%), respectively, compared with the control treatment, which recorded the lowest value (7.81 Plant m⁻²). This can be attributed to the effectiveness and high efficiency of these herbicides, as their components contain active ingredients that inhibit the enzymes responsible for the biosynthesis of amino

acids, leading to suppression of vital and physiological activities within the plant. This resulted in deterioration of cell division processes, and these combined factors led to the death of weed plants and a reduction in their density. These findings are consistent with those reported by [11,12], who confirmed that the use of chemical herbicides resulted in a reduction in the number of narrow-leaved weed plants.

The results of the interaction between fertilizers and herbicides presented in Table (5) at Kabar Al-Abd site indicated the superiority of F4 in combination with the herbicides (MIX and Discipline OD), recording the lowest values of the trait (2.0 and 2.33 Plant m⁻²), respectively. In contrast, the control treatment without fertilizer (T1) combined with the control without herbicide recorded the highest value of the trait (10.67 Plant m⁻²). At Al-Khufsan site, the results showed the superiority of fertilizer treatment T4 in combination with the herbicide (MIX), recording the lowest value of the trait (2.50 Plant m⁻²), with a reduction percentage of (164.4%) compared with the control treatment of the same fertilizer level.

Meanwhile, the control treatment without fertilizer (T1) combined with the control without herbicide recorded the highest value of the trait (13.74 Plant m⁻²).

3.2. Number of (B.L.W.) Plant m⁻².

The results presented in Table (3) regarding the effect of fertilizers on the trait of broad-leaved weed density at Kabar Al-Abd site indicated the superiority of treatment T2 over the other treatments, recording the lowest weed density (22.13 Plant m⁻²), with a reduction percentage of (41.57%) compared with the control treatment T1, which recorded the highest value of the trait (31.33 Plant m⁻²). At Al-Khufsan site, treatments T2 and T4 showed superiority over the other treatments, recording the lowest values of the trait (26.56 and 26.13 Plant m⁻²), respectively, which did not differ significantly from T3 that recorded (28.61 Plant m⁻²). The reduction percentages were (42.65%, 45.0%, and 32.43%), respectively, compared with the control treatment T1, which recorded the highest value of the trait (37.89 Plant m⁻²).

The results presented in Table (4) regarding the effect of herbicide treatments at Kabar Al-Abd site indicated a significant superiority of both herbicide treatments (MIX and Discipline OD), which recorded the lowest values of the trait (19.78 and 18.78 Plant m⁻²), with efficiency percentages of (48.89% and 51.43%), respectively, compared with the control treatment, which recorded the lowest value of the trait (38.67 Plant m⁻²). At Al-Khufsan site, the same treatments also showed superiority, recording the lowest values of the trait (23.29 and 23.64 Plant m⁻²), with treatment efficiency percentages of (46.11% and 45.30%), respectively, compared with the control treatment, which recorded the lowest value (43.22 Plant m⁻²). This may be attributed to the fact that these herbicides are systemic and selective with dual action, as they are

absorbed through both roots and leaves, translocated within the plant, and lead to growth inhibition and elimination or reduction of weed plants. These findings are consistent with those reported by [13]. Observations of the interaction between fertilizers and herbicides (Table 5) at Kabar Al-Abd site indicated a significant superiority of treatment T3 in combination with the herbicide (Discipline OD), recording the lowest value of the trait (16.00 Plant m⁻²), with an efficiency percentage of (24.98%) compared with the control treatment of the same fertilizer level. Meanwhile, the control treatment without fertilizer (T1) combined with the control without herbicide recorded the highest value of the trait (52.00 Plant m⁻²). At Al-Khufsan site, the results showed the superiority of fertilizer treatments T2 and T4 in combination with herbicides (MIX and Discipline OD), recording the lowest values of the trait (20.53, 20.77, 21.00, and 21.23 Plant m⁻²), respectively, which did not differ significantly from the other fertilizer treatments. The control treatment without fertilizer (T1) combined with the control without herbicide recorded the highest value of the trait (60.00 Plant m⁻²).

3.3. Total Weed Number Plant m⁻².

The results presented in Table (3) regarding the effect of fertilizers on the total weed density at Kabar Al-Abd site indicated a significant superiority of treatment T2 over the other treatments, recording the lowest weed density (26.02 Plant m⁻²), with a reduction percentage of (47.31%) compared with the control treatment T1, which recorded the highest value of the trait (38.33 Plant m⁻²). At Al-Khufsan site, treatment T4 showed superiority over the other treatments, recording the lowest value of the trait (29.89 Plant m⁻²), which did not differ

significantly from T2, which recorded (31.24 Plant m⁻²). The reduction percentages were (56.20% and 49.45%), respectively, compared with the control treatment T1, which recorded the highest value of the trait (46.69 Plant m⁻²).

Observations of the effect of herbicide treatments (Table 4) at Kabar Al-Abd site indicated a significant superiority of both herbicide treatments (MIX and Discipline OD), recording the lowest values of the trait (22.78 and 21.83 Plant m⁻²), with efficiency percentages of (49.31% and 51.42%), respectively, compared with the control treatment, which recorded the lowest value of the trait (44.94 Plant m⁻²). At Al-Khufsan site, the same treatments also showed superiority, recording the lowest values of the trait (26.96 and 27.46 Plant m⁻²), with treatment efficiency percentages of (47.17% and 48.19%), respectively, compared with the control treatment, which recorded the lowest value of the trait (51.04 Plant m⁻²). The reduction in weed density under herbicide treatments may be attributed to the effectiveness of the herbicides used in the study and their impact on both narrow-leaved and broad-leaved weed plants. This led to a decrease in the total number of weeds in these treatments, while promoting wheat growth and intensifying competition between wheat and weeds for available growth resources. Consequently, a large number of weed plants were unable to survive and persist, resulting in a reduction of their density within the same treatment [14].

Observations of the interaction between fertilizers and herbicides (Table 5) at Kabar Al-Abd site indicated the superiority of treatment T3 in combination with the herbicide (Discipline OD), recording the lowest value of the trait (18.67 Plant m⁻²), with a reduction percentage of 29.09% compared with the control treatment of the same fertilizer level. Meanwhile, the control treatment without fertilizer (T1) combined with the control without

herbicide recorded the highest value of the trait (62.67 Plant m⁻²). At Al-Khufsan site, the results showed the superiority of fertilizer treatment T4 in combination with the herbicide (MIX), recording the lowest value of the trait (23.27 Plant m⁻²), while the control treatment without fertilizer (T1) combined with the control without herbicide recorded the highest value of the trait (73.47 Plant m⁻²).

3.4. Dry weight (N.L.W.) g m⁻².

The results presented in Table (3) regarding the effect of fertilizers on narrow-leaved weed dry weight at Kabar Al-Abd site indicated the superiority of treatment T4 over the other treatments, recording the lowest weed weight (1.60 g m⁻²), which did not differ significantly from treatment T5, which recorded (1.84 g m⁻²). The reduction percentages were (139.38% and 108.15%), respectively, compared with the control treatment T1, which recorded the highest value of the trait (3.83 g m⁻²). At Al-Khufsan site, treatment T4 also showed significant superiority over the other treatments, recording the lowest value of the trait (2.22 g m⁻²), with a reduction percentage of (128.83%) compared with the control treatment T1, which recorded the highest value of the trait (5.08 g m⁻²).

Observations presented in Table (4) regarding the effect of herbicide treatments at Kabar Al-Abd site indicated a significant superiority of both herbicide treatments (MIX and Discipline OD), which recorded the lowest values of the trait (1.60 and 1.60 g m⁻²), with efficiency percentages of (53.07% and 53.07%), respectively, compared with the control treatment, which recorded the lowest value of the trait (3.41 g m⁻²). At Al-Khufsan site, the same treatments also showed superiority, recording the lowest values of

the trait (2.23 and 2.18 g m⁻²), with treatment efficiency percentages of (51.23% and 52.40%), respectively, compared with the control treatment, which recorded the lowest value of the trait (4.58 g m⁻²). This reduction may be attributed to the effectiveness of the herbicides used in the study and their specificity in killing weed plants, which provided the opportunity for the crop plants to grow, thereby reducing weed numbers, suppressing their growth, and consequently decreasing the dry weight of the remaining weeds. These results are consistent with those reported by [15], who indicated that the use of herbicides reduced weed dry biomass.

The results of the interaction between fertilizers and herbicides (Table 5) at Kabar Al-Abd site indicated the superiority of all fertilizer treatments in combination with both herbicides (MIX and Discipline OD), which recorded the lowest values of the trait. Meanwhile, the control treatment without fertilizer (T1) combined with the control without herbicide recorded the highest value of the trait (5.72 g m⁻²). At Al-Khufsan site, the results showed the superiority of fertilizer treatment T4 in combination with the herbicide (MIX), recording the lowest value of the trait (1.44 g m⁻²), with an efficiency percentage of (63.72%) compared with the control treatment of the same fertilizer level. Meanwhile, the control treatment without fertilizer (T1) combined with the control without herbicide recorded the highest value of the trait (7.44 g m⁻²).

3.5. Dry weight (B.L.W.) g m⁻².

The results presented in Table (3) regarding the effect of fertilizers on broad-leaved weed dry weight at Kabar Al-Abd site indicated the superiority of treatments T2 and T4 over the other treatments, recording the lowest weed weights (21.76

and 22.00 g m⁻²), with reduction percentages of (56.11% and 54.40%), respectively, compared with the control treatment T1, which recorded the highest value of the trait (33.97 g m⁻²). At Al-Khufsan site, treatments T2 and T4 also showed significant superiority over the other treatments, recording the lowest values of the trait (25.71 and 26.07 g m⁻²), with reduction percentages of (54.57% and 52.43%) compared with the control treatment T1, which recorded the highest value of the trait (39.74 g m⁻²). This may be attributed to the fact that soil-applied fertilizers increased nutrient availability, which was more effectively utilized by weeds in the field compared with foliar fertilization [10].

Observations presented in Table (4) regarding the effect of herbicide treatments at Kabar Al-Abd site indicated a significant superiority of both herbicide treatments (MIX and Discipline OD), recording the lowest values of the trait (20.17 and 20.23 g m⁻²), with efficiency percentages of (44.22% and 44.05%), respectively, compared with the control treatment, which recorded the lowest value of the trait (36.16 g m⁻²). At Al-Khufsan site, the same treatments also showed superiority, recording the lowest values of the trait (23.82 and 23.86 g m⁻²), with efficiency percentages of (44.41% and 44.31%), respectively, compared with the control treatment, which recorded the lowest value of the trait (42.85 g m⁻²). This reduction may be attributed to the fact that chemical herbicides reduced the dry weight of broad-leaved weed plants due to their specificity in eliminating them and inhibiting their growth. These findings are consistent with those reported by [16], who observed a reduction in broad-leaved weed biomass when chemical herbicides were applied in wheat fields.

The results of the interaction between fertilizers and herbicides (Table 5) at Kabar Al-Abd site indicated a significant superiority of treatments T2 and T4 in combination with the herbicide (MIX), and T4 and T6 in combination with the herbicide (Discipline OD), recording the lowest values of the trait (17.93, 17.87, 17.73, and 17.27 g m⁻²), which did not differ significantly from treatments T6 and T2 for both herbicides, respectively. Meanwhile, the control treatment without fertilizer (T1) combined with the control without herbicide recorded the highest value of the trait (51.47 g m⁻²). At Al-Khufsan site, the same treatments also showed significant superiority for both herbicides, recording the lowest values of the trait, while the control treatment without fertilizer (T1) combined with the control without herbicide recorded the highest value of the trait (59.47 g m⁻²).

3.6. Total Dry weight weeds g m⁻².

The results presented in Table (3) regarding the effect of fertilizers on total weed dry weight at Kabar Al-Abd site indicated the superiority of treatments T2 and T4 over the other treatments, recording the lowest weed weights (23.87 and 23.60 g m⁻²), with reduction percentages of (58.35% and 60.46%), respectively, compared with the control treatment T1, which recorded the highest value of the trait (37.80 g m⁻²). At Al-Khufsan site, the same treatments also showed significant superiority over the other treatments, recording the lowest values of the trait (28.56 and 28.29 g m⁻²), with reduction percentages of (56.93% and 58.43%), respectively, compared with the control treatment T1, which recorded the highest value of the trait (44.82 g m⁻²). This may be attributed to the fact that weeds are more efficient at competing with the crop for soil-applied fertilizers but less efficient

in competing for foliar-applied fertilizers [10].

The results of the effect of herbicide treatments (Table 4) at Kabar Al-Abd site indicated a significant superiority of both herbicide treatments (MIX and Discipline OD), recording the lowest values of the trait (21.80 and 21.90 g m⁻²), with efficiency percentages of (44.79% and 44.64%), respectively, compared with the control treatment, which recorded the lowest value of the trait (39.56 g m⁻²). At Al-Khufsan site, the same treatments also showed superiority, recording the lowest values of the trait (26.05 and 26.04 g m⁻²), with efficiency percentages of (45.07% and 45.09%), respectively, compared with the control treatment, which recorded the lowest value of the trait (47.43 g m⁻²). This reduction may be attributed to the effectiveness and efficiency of these herbicides, as they are systemic and selective, absorbed through both roots and leaves, and translocated throughout the plant. They act as inhibitors of amino acid biosynthesis and affect protein formation in the plant, thereby halting cell division and plant growth, which suppresses the dry weight of both narrow-leaved and broad-leaved weeds. These findings are consistent with those reported by [17].

The results of the interaction between fertilizers and herbicides (Table 5) at Kabar Al-Abd site indicated the superiority of treatment T6 in combination with both herbicides (MIX and Discipline OD), recording the lowest values of the trait (19.60 and 18.50 g m⁻²), which did not differ significantly from treatments T2 and T4 for both herbicides. Meanwhile, the control treatment without fertilizer (T1) combined with the control without herbicide recorded the highest value of the trait (57.19 g m⁻²). At Al-Khufsan site, treatments T2, T4, and T6 in combination with both herbicides (MIX and Discipline

OD) also showed significant superiority, recording the lowest values of the trait, while the control treatment without fertilizer (T1) combined with the control without herbicide recorded the highest value of the trait (66.90 g m⁻²).

3.7. Number of spike Spike m⁻².

The results presented in Table (3) regarding the effect of fertilizers on the number of spikes at Kabar Al-Abd site indicated a significant superiority of treatment T6, which recorded the highest value of the trait (311.33 Spike m⁻²), with an increase of 27.65% compared with the control treatment T1, which recorded the lowest value of the trait (243.89 Spike m⁻²). At Al-Khufsan site, treatment T6 also showed superiority, recording the highest value of the trait (340.11 Spike m⁻²), with an increase of 13.5%, while the control treatment recorded the lowest value of the trait (299.65 Spike m⁻²).

The results presented in Table (4) regarding the effect of herbicide treatments at Kabar Al-Abd site indicated the superiority of both herbicide treatments (MIX and Discipline OD), which recorded the highest values of the trait (298.72 and 296.33 Spike m⁻²), with increases of 21.79% and 20.81%, respectively, compared with the control treatment, which recorded the lowest number of spikes (245.28 spikes.m²). At Al-Khufsan site, treatments with both herbicides (MIX and Discipline OD) also showed superiority, recording the highest values of the trait (339.55 and 332.59 Spike m⁻²), with increases of 12.59% and 10.28%, respectively, while the control treatment recorded the lowest number of spikes (301.58 Spike m⁻²). This improvement may be attributed to the effectiveness of the herbicides in reducing weed density and dry biomass, which allowed wheat plants to optimally utilize growth requirements, leading to increased photosynthetic rates

and translocation of photosynthates. This, in turn, and ultimately led to a higher number of spikes. These findings are consistent with those reported by [18], who indicated that herbicide application increased spike numbers.

The results of the interaction between fertilizers and herbicides (Table 5) at Kabar Al-Abd site indicated a significant superiority of treatment T6 in combination with herbicide MIX, which recorded the highest value of the trait (342.67 Spike m⁻²), with an increase of 36.7% compared with the control treatment for the same combination. Meanwhile, the control treatments T1 and T5 combined with the control without herbicide recorded the lowest values of the trait (231.33 and 235.33 Spike m⁻²), respectively. At Al-Khufsan site, treatment T6 with herbicide MIX also showed superiority, recording the highest value of the trait (366.43 Spike m⁻²), with an increase of 16.73% compared with the control treatment for the same combination, which did not differ significantly from T2 and T3 with herbicide MIX and T6 with herbicide Discipline OD. Meanwhile, the control treatments without fertilizer (T1 and T3) combined with the control without herbicide recorded the lowest values of the trait (268.90 and 290.27 Spike m⁻²).

3.8. Weight 1000-Grain g .

The results presented in Table (3) regarding the effect of fertilizers on thousand-grain weight at Kabar Al-Abd site indicated the superiority of treatments T4 and T6, which recorded the highest values of the trait (32.33 and 32.29 g), respectively, and did not differ significantly from treatments T2 and T5. Meanwhile, the control treatment T1 and treatment T3 recorded the lowest values of the trait (30.04 and 30.16 g). At Al-

Khufsan site, treatments T4 and T6 also showed superiority, recording the highest values of the trait (33.19 and 33.35 g), respectively, which did not differ significantly from T2, T3, and T5. These results are compared with the control treatment T1, which recorded the lowest value of the trait (29.79 g). Foliar nutrition affects the nutritional status and grain production of winter wheat through its direct impact on vegetative and reproductive growth. In combination with soil-applied chemical fertilizers, especially when applied at sufficient rates and timing, foliar fertilization has a significant effect on wheat growth and yield, leading to a notable increase in grain weight [19].

The results presented in Table (4) regarding the effect of herbicide treatments at Kabar Al-Abd site indicated no significant differences between the herbicide treatments. However, at Al-Khufsan site, treatments with both herbicides (MIX and Discipline OD) showed superiority, recording the highest values of the trait (33.47 and 32.76 g), respectively, while the control treatment recorded the lowest weight (29.60 g). This outcome is attributed to the provision of a favorable environment for the crop and its ability to utilize growth requirements efficiently, which enhanced photosynthetic efficiency. This, in turn, positively affected physiological activities and the translocation of photosynthates to the grains, which serve as the final sink, ultimately increasing grain weight. The absence of weed competition, or the reduction in weed number and dry weight, allowed the crop to utilize more water and essential resources, directly affecting thousand-grain weight. The absence of competitive pressure thus had a positive impact on increasing the weight of 1000 grains [20].

The results of the interaction between fertilizers and herbicides (Table 5) at Kabar Al-Abd site indicated the superiority of treatment T6 in combination with both herbicides (MIX and Discipline OD), recording the highest values of the trait (33.23 and 33.07 g), respectively, which did not differ significantly from treatments T2, T4, and T6 for both herbicides. Meanwhile, the control treatment T1 combined with the control without herbicide recorded the lowest value of the trait (28.62 g). At Al-Khufsan site, treatment T4 in combination with herbicide (MIX) and treatment T6 with herbicide (Discipline OD) showed superiority, recording the highest values of the trait (34.88 and 34.79 g), which did not differ significantly from all other treatments with either herbicide (MIX and Discipline OD). Meanwhile, the control treatment T1 combined with the control without herbicide recorded the lowest value of the trait (26.88 g), which did not differ significantly from T2 and T3 combined with the control without herbicide.

3.9. Grain Yield Kg ha⁻¹.

The results presented in Table (3) regarding the effect of fertilizers on grain yield at Kabar Al-Abd site indicated the superiority of treatment T6, which recorded the highest value of the trait (2924.7 Kg ha⁻¹), with an increase percentage of (52.05%) compared with the control treatment T1, which recorded the lowest value of the trait (1923.5 Kg ha⁻¹). At Al-Khufsan site, treatment T6 also showed superiority, recording the highest value of the trait (3256.9 Kg ha⁻¹), with an increase percentage of (34.4%) compared with the control treatment, which recorded the lowest value (2423.3 Kg ha⁻¹). This superiority is attributed to the application of the fertilizer coinciding with the transition from the stem elongation stage to

the heading stage, which is highly effective during this phase. Wheat plants require substantial nutritional support for rapid vertical growth and reproductive development, which enhances stem strength, facilitates optimal spike formation, and promotes grain filling. Foliar nutrition applied at the correct rate and timing can also enhance the efficiency of added chemical fertilizers in wheat production [19].

The results of the effect of herbicide treatments (Table 4) at Kabar Al-Abd site indicated a significant superiority of the herbicide Discipline OD, which recorded the highest value of the trait (2777.0 Kg ha⁻¹), with an increase percentage of (42.08%) compared with the control treatment, which recorded the lowest weight (1954.5 Kg ha⁻¹). At Al-Khufsan site, the herbicide treatment MIX showed superiority, recording the highest value of the trait (3101.9 Kg ha⁻¹), with an increase percentage of (31.26%) compared with the control treatment, which recorded the lowest weight (2363.1 Kg ha⁻¹). This outcome is attributed to the efficiency of the herbicides used and their substantial impact on weed growth, including both narrow-leaved and broad-leaved types, in the blocks treated with chemical herbicides from the early growth stages of the crop until maturity. This allowed wheat plants to utilize growth resources more effectively, improving photosynthetic efficiency, increasing the translocation of assimilated dry matter to the grains during grain formation and filling, and enhancing growth and yield-related traits, particularly spike number and thousand-grain weight, which ultimately increased grain yield. These findings are consistent with the results reported by [1].

The results of the interaction between fertilizers and herbicides (Table 5) at Kabar Al-Abd site indicated a significant

superiority of treatment T6 in combination with both herbicides (MIX and Discipline OD), recording the highest values of the trait (3223.6 and 3242.7 Kg ha⁻¹) with increase percentages of (67.67% and 48.11%), respectively, compared with the control treatment for each herbicide. Meanwhile, the control treatment T1 combined with the control without herbicide recorded the lowest value of the trait (1598.9 Kg ha⁻¹). At Al-Khufsan site, treatment T6 in combination with both herbicides (MIX and Discipline OD) also showed significant superiority, recording the highest values of the trait (3618.7 and 3568.5 Kg ha⁻¹) with increase percentages of (35.12% and 34.54%), respectively, compared with the control treatment for each herbicide. Meanwhile, the control treatments T1 and T3 combined with the control without herbicide recorded the lowest values of the trait (1939.3 and 2231.1 Kg ha⁻¹).

Conclusions:

Based on the results of this experiment, it is recommended to adopt the interaction of fertilizer treatment T6 with herbicide MIX as a strategic option for farmers in the Kabar Al-Abd and Al-Khufsan regions, due to its maximum effectiveness in increasing grain yield by over 67%. It is also recommended to use both herbicides (MIX and Discipline OD) in combination with balanced fertilization to reduce weed dry weight by up to 60%, thereby minimizing crop competition. Additional research is suggested to test these interactions under varied climatic and environmental conditions to ensure the sustainability of these results in other geographical areas.

Table (2) The effect of Herbicide's Weeds and the growth traits and yield of wheat during the 2024-2025 season in both locations.

Herbicides	Number of Plant N.W. m ⁻²	Number of Plant B.W. m ⁻²	Total Weed Number Plant m ⁻²	Dry weight N.W. g m ⁻²	Dry weight B.W. g m ⁻²	Total Dry weight weeds g m ⁻²	Number of spike Spike m ⁻²	Weight 1000-Grain (g)	Grain Yield g m ⁻²
Kabir Al-Abd location									
Control	6.28	38.67	44.94	3.41	36.16	39.56	245.28	30.319	1954.5
Mix	3	19.78	22.78	1.63	20.17	21.8	298.72	31.689	2678.8
Discipline OD	3.06	18.78	21.83	1.63	20.23	21.86	296.33	31.694	2777
L.S.D	0.2181	1.1018	1.091	0.1069	1.0943	1.0624	3.0965	1.5632	68.379
Al-Khafsan location									
Control	7.81	43.22	51.04	4.58	42.85	47.43	301.58	29.604	2363.1
Mix	3.67	23.29	26.96	2.23	23.82	26.05	339.55	33.472	3101.9
Discipline OD	3.81	23.64	27.46	2.18	23.86	26.04	332.59	32.76	3037.9
L.S.D	0.39	1.8995	2.0501	0.2447	0.9173	0.8913	8.7706	0.8921	100.29

Table (3) The effect of fertilizers on the growth Weeds and yield of wheat during the 2024-2025 season in both locations.

Fertilizers	Number of Plant N.W. m ⁻²	Number of Plant B.W. m ⁻²	Total Weed Number Plant m ⁻²	Dry weight N.W. g m ⁻²	Dry weight B.W. g m ⁻²	Total Dry weight weeds g m ⁻²	Number of spike Spike m ⁻²	Weight 1000-Grain (g)	Grain Yield g m ⁻²
Kabir Al-Abd location									
F1	7.00	31.33	38.33	3.83	33.97	37.80	243.89	30.040	1923.5
F2	3.89	22.13	26.02	2.12	21.76	23.87	283.33	31.199	2481.3
F3	3.56	25.33	28.89	1.96	25.52	27.48	268.78	30.161	2341.6
F4	3.00	24.09	27.09	1.60	22.00	23.60	296.11	32.334	2659.2
F5	3.44	25.29	28.73	1.84	25.44	27.28	277.22	31.382	2490.2
F6	3.78	26.27	30.04	1.97	24.42	26.39	311.33	32.289	2924.7
L.S.D	0.4565	0.784	1.0383	0.2603	0.7837	0.7739	7.7668	1.3262	34.27
Al-Khafsan location									
F1	8.80	37.89	46.69	5.08	39.74	44.82	299.65	29.792	2423.3
F2	4.68	26.56	31.24	2.85	25.71	28.56	337.37	31.889	2901
F3	4.36	28.61	32.97	2.62	30.49	33.11	322.33	31.486	2720.8
F4	3.76	26.13	29.89	2.22	26.07	28.29	325.37	33.194	2873.2
F5	4.34	29.97	34.31	2.49	30.09	32.58	322.60	31.965	2830.6
F6	4.64	31.17	35.81	2.7	28.97	31.67	340.11	33.347	3256.9
L.S.D	0.2086	2.8037	2.6842	0.2363	0.8789	0.7989	14.38	2.6975	69.252

Table (4) The effect of interaction between Herbicide's and Fertilizers on the Weeds traits and yield of wheat during the 2024-2025 season in both locations.

Herbicides	Fertilizers	Number of N.W. Plant m ⁻²	Number of B.W. Plant m ⁻²	Total Weed Number Plant m ⁻²	Dry weight N.W. g m ⁻²	Dry weight B.W. g m ⁻²	Total Dry weight weeds g m ⁻²	Number of spike m ⁻²	Weight 1000-Grain (g)	Grain Yield g m ⁻²
Kabir Al-Abd location										
Control without herbicides	F1	10.67	52.0	62.67	5.72	51.47	57.19	231.33	28.619	1598.9
	F2	5.67	30.4	36.07	3.11	29.19	32.29	244.67	30.531	1846.2
	F3	5.33	38.0	43.33	2.93	33.62	36.55	245.33	29.782	1930.4
	F4	4.67	33.6	38.27	2.54	30.4	32.94	256	31.636	2104.7
	F5	5.33	37.2	42.53	2.89	34.46	37.35	235.33	30.78	1938.7
	F6	6.0	40.8	46.8	3.25	37.8	41.05	259	30.566	2307.9
Mix	F1	5.33	20.67	26	2.93	25.41	28.34	250.67	30.667	1982.2
	F2	3.0	18.67	21.67	1.64	17.93	19.58	303.67	31.667	2662
	F3	2.67	22.0	24.67	1.5	21.2	22.70	286	30.433	2588.5
	F4	2.0	17.33	19.33	1.08	17.87	18.95	317.33	32.733	2888.1
	F5	2.33	21.33	23.67	1.22	20.4	21.62	292	31.4	2728.6
	F6	2.67	18.67	21.33	1.4	18.2	19.60	342.67	33.233	3223.6
Discipline OD	F1	5.0	21.33	26.33	2.85	25.03	27.88	249.67	30.833	2189.4
	F2	3.0	17.33	20.33	1.61	18.15	19.75	301.67	31.4	2935.7
	F3	2.67	16.0	18.67	1.46	21.73	23.20	275	30.267	2505.9
	F4	2.33	21.33	23.67	1.18	17.73	18.92	315	32.633	2984.8
	F5	2.67	17.33	20.0	1.4	21.47	22.87	304.33	31.967	2803.3
	F6	2.67	19.33	22.0	1.26	17.27	18.53	332.33	33.067	3242.7
L.S.D		1.4362	2.2021	2.5272	0.7636	2.1604	2.4152	7.9248	1.7246	110.76

Al-Khafsan location										
Control without herbicides	F1	13.47	60	73.47	7.44	59.47	66.9	268.9	26.87 5	1939.3
	F2	6.91	38.13	45.04	4.1	34.82	38.93	316.0 3	27.75	2501.4
	F3	6.51	39.87	46.38	3.81	40.61	44.42	290.2 7	29.5	2231.1
	F4	5.7	36.4	42.1	3.63	36.15	39.78	316.0 3	31	2514.7
	F5	6.83	41.6	48.43	3.93	41.02	44.95	313.9	30.20 8	2408.5
	F6	7.47	43.33	50.8	4.56	45.03	49.59	304.3 3	32.29 2	2583.6
Mix	F1	6.61	27.07	33.68	3.97	30.23	34.2	313.9	32.08 3	2678.1
	F2	3.63	20.53	24.17	2.37	20.85	23.22	355.1 8	34.29 2	3110.8
	F3	3.2	22.87	26.07	2.05	25.11	27.15	351.1 3	33.54 2	2992.3
	F4	2.5	20.77	23.27	1.44	21.11	22.54	339.4 3	34.87 5	3169.2
	F5	2.83	23.8	26.63	1.65	24.15	25.8	311.2	33.08 3	3042
	F6	3.23	24.73	27.97	1.89	21.51	23.39	366.4 3	32.95 8	3618.7
Discipline OD	F1	6.33	26.6	32.93	3.84	29.53	33.37	316.1 5	30.41 7	2652.3
	F2	3.5	21.0	24.5	2.09	21.44	23.53	340.9	33.62 5	3090.8
	F3	3.37	23.1	26.47	2.02	25.75	27.77	325.6	31.41 7	2939
	F4	3.07	21.23	24.3	1.61	20.95	22.55	320.6 5	33.70 8	2935.7
	F5	3.37	24.5	27.87	1.89	25.09	26.98	342.7	32.60 4	3041.3
	F6	3.23	25.43	28.67	1.64	20.39	22.03	349.5 6	34.79 2	3568.5
L.S.D		0.922 6	4.269 2	4.107 1	0.471 6	1.640 4	1.723 6	21.02	2.971 7	11.724

REFERENCES.

- [1] Aljuburi, D. F., Aziz, M. M., Sami, A. S., Alsamadany, H. A., & Kutby, A. M. (2025). EVALUATION OF DIFFERENT CONCENTRATIONS OF TARZEC AND AXIAL HERBICIDES AND SEEDING RATES ON WHEAT (*Triticum aestivum* L.) GROWTH, YIELD, AND WEED CONTROL. *Mesopotamia Journal of Agriculture*, 53(1) 91-109. <https://doi.org/10.33899/mja.2025.156328.15221>.
- [2] FAO. (2025). Cereal Supply and Demand Brief. Food and Agriculture Organization of the United Nations. <https://www.fao.org/worldfoodsituations/cfdb/en/>.
- [3] CSGIS, commission of statistical and GIS.(2024). Report wheat and Barly production. <https://www.cosit.gov.iq/ar/agri-stat/veg-prod>.
- [4] İslamzade, T., Guliyev, S., Guliyeva, Z., Qaribova, S., & İslamzade, R. (2025). Effect of foliar fertilization applied at different phenological stages on wheat (*Triticum aestivum* L.) yield and grain nutrient content under greenhouse conditions. *Eurasian Journal of Soil Science*, 14(2), 133-139. <https://dergipark.org.tr/en/pub/ejss/article/1629626>.
- [5] Poudel, A., Singh, S. K., Jiménez-Ballesta, R., Jatav, S. S., Patra, A.,&Pandey, A. (2023). Effect of nano-phosphorus formulation on growth, yield and nutritional quality of wheat under semi-arid climate. *Agronomy*, 13(3), 768. <https://doi.org/10.3390/agr13030768>.
- [6] Reddy, K. S., Shivay, Y. S., Kumar, D., Parida, B. K., Bora, R., Borate, R. B., ...& Alekhya, G. (2025). Nano DAP augments productivity, phosphorus use efficiency, and profitability of spring wheat. *Scientific Reports*, 15(1), 24771. doi.org/10.1038/s41598-025-92364-3.
- [7] Murthy S., I., Jolly, G. E.,&John, A. P. (2025). Allelopathy in weed management: a comprehensive review. *International Journal of Plant&Soil Science*, 37(5), 96-104. https://www.researchgate.net/publication/391406490_Allelopathy_in_Weed_Management_A_Comprehensive_Review.
- [8] Al-Jubouri, O. S.,&Al-Tawash, S. A. (2023). Effect of chemical control on weed growth and wheat (*Triticum aestivum* L.) yield components. *Journal of Agricultural Science and Technology*, 25(4), 815-827. https://www.researchgate.net/publication/358494042_EFFECT_OF_CHEMICAL_CONTROL_OF_WEED_IN_GROWTH_AND_YIELD_OF_FIVE_VARIETY_OF_TRITICUM_AESTIVUM_L_WHEAT.
- [9] Al-Rawi, K. M. and Abdel-Aziz K. (2000). Design and analysis of experiments. University of Al Mosul. College of Agriculture and Forestry. Dar Al-Kutub for printing and publishing. <https://uomosul.edu.iq/library/>.
- [10] Al-Nuaimi, M. A. H. (2025). *Evaluation of weed control herbicides and DAP fertilization systems on growth and yield of two bread wheat cultivars*

and associated weeds (Master's thesis, University of Mosul, College of Agriculture and Forestry). University of Mosul. <https://uomosul.edu.iq/agriculture/2025/04/page/13/>.

- [11] Wahab, S. E. A., & Aljuburi, D. F. (2023a). Effect Concentrations of LIMITLESS WG Herbicides and Varieties on the Growth and Yield of Wheat (*Triticum aestivum* L.) and Associated Weeds. In IOP Conference Series: Earth and Environmental Science (Vol. 1262, No. 5, p. 052045). IOP Publishing. [doi:10.1088/1755-1315/1262/5/052045](https://doi.org/10.1088/1755-1315/1262/5/052045).
- [12] Mamnoie, E., Karaminejad, M. R., Aliverdi, A., & Moeini, M. M. (2022). Application efficacy of newly released pre-mixed herbicide in winter wheat: Joystick®. <https://doi.org/10.15159/jas.22.13>
- [13] Wahab, S. E. A., & Aljuburi, D. F. (2023b). Evaluation of Efficiency Different Concentrations of SURAGE Herbicides on the Growth and Yield of Two Varieties of Wheat (*Triticum aestivum* L.) and Associated Weeds. In IOP Conference Series: Earth and Environmental Science (Vol. 1213, No. 1, p. 012037). IOP Publishing. [doi:10.1088/1755-1315/1213/1/012037](https://doi.org/10.1088/1755-1315/1213/1/012037).
- [14] Yedra, V. Á., Otero, P., Prieto, M. A., Simal- Gandara, J., Reigosa, M. J., Sánchez- Moreiras, A. M., and Hussain, M. I. (2023). Testing the role of allelochemicals in different wheat cultivars to sustainably manage weeds. *Pest Management Science*, 79 (7): 2625-2638. [DOI:10.1002/ps.7444](https://doi.org/10.1002/ps.7444).
- [15] El-Taif, M.R.A. (2021). Sensitivity of Wheat Genotypes to Newly Introduced Selective Herbicides. *Arab Journal of Plant Protection*, 39(1): 55-60. <https://doi.org/10.22268/AJPP-39.1.055060>.
- [16] Hameed, H. M. (2022). Efficiency of Herbicide Combinations Different to Control Weed of Wheat Crop (Sham 6) (*Triticum aestivum* L.) *Journal of Kirkuk University for Agricultural Sciences*, 13(3). <https://doaj.org/article/9fe05d02a7fe4438b26a4175cbde07f5>.
- [17] Razak H. (2017). Effects of pesticides on some wheat varieties (*Triticum aestivum* L.) Under condition Of AL-Muthanna. *AL-Muthanna journal* 5 (1): 65-73. <https://search.emarefa.net/detail/BIM-867344>.
- [18] Safi, S. M., R. A. A. Al- khaldy and W. F. hammood.(2022). Evaluation of the efficiency of some herbicides in controlling weeds in wheat (*Triticum aestivum* L.). *Res. Crop.* 23 (1): 21-25. DOI: [10.31830/23487542.2022.004](https://doi.org/10.31830/23487542.2022.004)
- [19] Sulstonov, K., Kholmurodova, G., Eshonkulov, J., Allanov, K., Sindarov, O., Khayitov, K., ... & Khaitov, B. (2025). Effect of integrative NPK soil and foliar nutrition on winter wheat (*Triticum aestivum* L.) productivity in irrigated arid lands. *Frontiers in Sustainable Food Systems*, 8, 1508913. [DOI 10.3389/fsufs.2024.1508913](https://doi.org/10.3389/fsufs.2024.1508913).
- [20] Mutlag, N. A., Al-Khaz'ali, A. J., Salman, K. A., Mahdi, R. H., & Jaber, T. N. (2023). Evaluation of herbicides pallas and limitless in controlling the narrow and broad leaf weeds within wheat crop fields and their effect on grain yield and it's components. *Iraqi journal of agricultural sciences*, 54(3), 860-867.

DOI: <https://doi.org/10.36103/ijas.v54i3.1769>.