Response of weeds accompanying wheat (*Triticum aestivum*) to selective herbicides, humic acid and effect on yield

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Abstract

A field experiment was carried out during the winter agricultural season (2024-2025) for wheat crops at the Field Crops Department Research Station affiliated with the College of Agriculture, Tikrit University to find out response of weeds accompanying wheat crop to selective herbicides, humic acid and its impact on crop traits. The factorial experiment was conducted using a Randomized Complete Block Design (RCBD) with three replicates. It included three factors: The first factor was wheat cultivar (Fayyad and Akja) , the second factor was humic acid application (distilled water as control), 1 kg/dunum, and 2 kg/dunum), the third factor was weed control method (control, hand weeding, Atlantis herbicide, and Tarzek herbicide). A quantity of NPK compound fertilizer (15.15.15) was application at a rate of 160 kg ha at once before planting, and urea fertilizer 46% N, an amount estimated at 200 kg ha, was added at once after germination in the branching stage on (1/31/2025) .The planting was on (11/18/2024) of Fayyad and Akja cultivars, and the seed quantity was 160 kg ha. Atlantis herbicide was sprayed at a concentration of 300 g per hectare and Tarzek herbicide at a concentration of 90 g per hectare in stages (4-6) leaves for narrow-leaved weeds and 2-4 leaves for broad-leaved weeds on (2/13/2025) with three replicates. The results showed that the manual weeding and Atlantis herbicide treatments achieved the highest significant weed control percentages, reaching 100% and 62.46%, respectively. The Fayyad cultivar recorded the highest significant values in plant height (95.31 cm), total yield (2.44 tons/ha), and protein content (13.71%). Additionally, the manual weeding treatment resulted in the highest leaf area (31 cm²) and plant height (96.41 cm). The application of humic acid at a rate of 2 kg/dunum significantly improved the 1000-grain weight (42.76 g), total yield (2.33 tons/ha), and plant height (96.12 cm). The highest significant value for total yield was observed in the triple interaction involving the Fayyad cultivar, Atlantis herbicide, and humic acid at 2 kg/dunum, reaching 3.09 tons/ha

Keywords. Wheat, herbicides and humic acid

Introduction

Wheat crop represents (*Triticum aestivum* L.) is one of the most important crops necessary for human life. The reason for this is that it works to achieve food security, as this crop represents the basic source of food for the population, in addition to its effective role in economic and social development, as its cultivation is widespread at high levels in the world,

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with large areas reaching 218 million hectares and a production capacity reaching 787.2 million tons [4]. In Iraq, this crop occupies the first place for its nutritional importance, as it is used in the bread industry in more than 60 countries in the world [6]. Its grains contain gluten and protein and are an important source of vitamins, mineral salts, and essential amino acids, in addition to carbohydrates, starch, and fats that humans need in their food. They are also antioxidants [5]. One of the challenges facing the development of this crop is the jungle plants, which are characterized by strength, ferocity, and high adaptation to environmental conditions, which enables them to compete highly for the main growth components (water, food, light, space) and overcome crop plants, causing losses of up to 70% (1). This use chemical that contributed to reducing the appearance of weeds and limiting their damage [7]. Studies have proven the difference between cultivars in their competitive ability in the accompanying weeds**,** and organic fertilizers (humic acid) represent one of the important factors for supporting the plant, as it improves the physical and chemical properties of the soil [12], in addition to being one of the scientific methods of agricultural operations that reduce the risk of intense competition between weeds and crop plants for the main growth components, which increases the competitive ability of crop plants. Therefore, the aim of the study was to find out response of weeds accompanying wheat crop to selective herbicides, humic acid and its impact on crop traits.

Materials and methods

A field experiment was conducted at the research station of the Department of Field Crops at the College of Agriculture, Tikrit University, during the winter season (2024-2025). The experiment aimed to find out response of weeds accompanying wheat crop to selective herbicides, humic acid and its impact on crop traits. Two cultivars of wheat (Fayyad and Akja) were planted on the date (18/11/2024). The factorial experiment was conducted using RCBD design with three replicates The experiment included three factors. The first factor was wheat cultivars (Fayyad and Akja) with a seed rate of 160 kg/ha; the second factor was humic acid application (distilled water as control, 1 kg/dunum, and 2 kg/dunum); and the third factor was weed control method (without control, hand weeding, Atlantis herbicide at 300 g/ha and Tarzek at 190 g/ha). The experimental land was plowed twice, leveled and divided into three main sections, each containing 24 plots with 10 planting rows spaced 20 cm apart, using a drip irrigation system. The area of each experimental unit was 2 × 2 m. Before planting, a compound fertilizer NPK (15:15:15) was applied at a rate of 160 kg/ha in a single application. Urea fertilizer (46% N) was applied at a rate of 200 kg/ha in one batch during the branching stage (31/1/2025). Humic acid (70% powder form) was dissolved in water and applied through

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irrigation at a rate of 1 kg/dunum for the first treatment (recommended rate) and 2 kg/dunum for the second treatment (double rate) on 13/2/2025. Herbicides were sprayed on the same date (13/2/2025). Soil chemical and physical properties were analyzed in the Laboratory of the College of Agriculture, Tikrit University (Table 1). Protein percentage was determined at the Ministry of Commerce, Quality Control Department, Grain Manufacturing Laboratory. The field experiment data were analyzed using SAS software, and mean comparisons were performed using Duncan's Multiple Range Test at the 0.05 probability level. The studied traits included: weed control percentage, flag leaf area, plant height, weight of 1000 grain, total grain yield, and protein percentage.

Table 1. Some physical and chemical properties of field soil

Measurements	Value of measurement	Perfect values	Unit
Texture of soil	Loam		-
Sand	47.6	40	%
Silt	40.3	40	%
Clay	12.1	20	%
Ph	7.58	6.8-7.2	-
Ec	7.73	Less than 2.5	$ds.m^{-1}$
N	13	20	ppm
P	6.1	8-15	ppm
K	119	50	ppm
Gypsum	13	Less than 10	%
Organic matter (OM)	0.9	1.2-2.5	%
Lime	20.5	Less than 15	%
Field capacity	29	30	%
Permanent wilting point	12	10	%

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Results and discussion

Weed control percentage

The results in Table 2 indicate that there were significant differences in weed control percentage among the weed control treatments. Manual weeding achieved the highest control rate, reaching 100%, while the Atlantis herbicide recorded the highest chemical control rate at 62.46%, followed by the Tarzek herbicide at 49.14%. This may be attributed to the mode of action of herbicides such as Atlantis, which inhibit the acetolactate synthase (ALS) enzyme, thereby preventing the synthesis of essential amino acids. These findings are consistent with those reported by [2]**.** No significant differences were observed between the cultivars in terms of weed control percentage, nor between the humic acid concentrations for this trait. For the interaction between cultivars and humic acid concentrations, the combination of the Fayyad cultivar with 1 kg/dunum humic acid recorded the highest significant value (57.98%), while the Akja cultivar with the same humic acid concentration recorded the lowest value (47.24%)**.** Regarding the interaction between cultivars and weed control methods, the Fayyad cultivar combined with the Atlantis herbicide achieved the highest control percentage (66.68%), followed by the Fayyad cultivar with the Tarzek herbicide (47.22%). For the interaction between humic acid concentration and weed control methods, the combination of 1 kg/dunum humic acid with the Atlantis herbicide recorded the highest value (70.80%), while the combination of 1 kg/dunum humic acid with the Tarzek herbicide recorded the lowest (39.65%). As for the triple interaction between cultivars, humic acid concentrations, and weed control methods, the highest value (73.40%) was obtained from the combination of the Akja cultivar with 2 kg/dunum humic acid and the Tarzek herbicide. In contrast, the lowest value (22.87%) was recorded for the combination of the Akja cultivar with 1 kg/dunum humic acid and the Tarzek herbicide.

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Table 2. Effect of cultivars, humic and weed control method on weed control percentage

Cultivars	Humic	Weed control method				Cultivars rate	Humic rate	Cultivars × Humic
		Without weed control	Hand weeding	Atlantis	Tarzek			
Fayyad	0	0.00 e	100.00 a	55.07 bc	50.70 cd	53.47 a	52.42 a	51.44 a
	1 kg/acre	0.00 e	100.00 a	75.50a b	56.43 bc		52.61 a	57.98 a
	2 kg/acre	0.00 e	100.00 a	69.48a b	34.53 cd		53.66 a	51.00 a
Akja	0	0.00 e	100.00 a	56.73 bc	56.93 bc	52.32 a		53.41 a
	1 kg/acre	0.00 e	100.00 a	66.10 bc	22.87 de			47.24 a
	2 kg/acre	0.00 e	100.00 a	51.90 bcd	73.40 ab			56.41 a
Cultivars × weed control method	Fayyad	0.00 d	100.00 a	66.68 b	47.22 c			
	Akja	0.00 d	100.00 a	58.24 bc	51.06 bc			
Humic x weed control method	0 kg/acre	0.00 d	100.00 a	55.90 bc	53.81 bc			
	1 kg/acre	0.00 d	100.00 a	70.80 b	39.65 c			
	2 kg/acre	0.00 d	100.00 a	60.69 bc	53.96 bc			
Weed control method rate		0.00 d	100.00 a	62.46 b	49.14 c			

Flag leaf area (cm)

The results in Table 3 show that herbicide treatments generally outperformed other treatments in the flag leaf area trait, although the differences were not statistically significant. Among the herbicides, Tarzek and Atlantis recorded the highest mean values, reaching 30.45 cm and 30.61 cm, respectively, compared to the control (without weed control), which recorded the lowest value of 20.53 cm. This increase may be attributed to the ability of herbicides to suppress weed growth, reduce weed density, and limit competition, thereby allowing the crop to utilize available growth factors more efficiently. This, in turn, enhanced carbon metabolism processes, positively influencing flag leaf expansion. These findings are consistent with those reported by [13] and [15]. No significant differences

were found between cultivars in terms of flag leaf area. Regarding humic acid concentrations, the application of 2 kg/dunum significantly increased flag leaf area, recording the highest value of 29.63 cm, followed by the no-humic treatment (27.95 cm), while 1 kg/dunum recorded the lowest value (26.87 cm). This effect is likely due to humic acid's role in enhancing cell membrane permeability, improving cell division and elongation, which promotes leaf expansion and increases leaf area. These results align with the findings of [9] and [14]. For the interaction between cultivars and humic acid concentrations, the combination of the Akja cultivar with 2 kg/dunum humic acid recorded the highest value (31.29 cm), whereas the Fayyad cultivar with 1 kg/dunum humic acid recorded the lowest (26.35 cm). For the interaction between cultivars and weed control methods, the Akja cultivar combined with the Atlantis herbicide achieved the highest flag leaf area (31.40 cm), while the Fayyad cultivar with the Atlantis herbicide recorded the lowest (29.81 cm). Regarding the interaction between humic acid concentrations and weed control methods, the combination of 2 kg/dunum humic acid with the Tarzek herbicide recorded the highest value (32.25 cm). For the triple interaction among cultivars, humic acid concentrations, and weed control methods, the highest value (35.73 cm) was obtained from the Akja cultivar with 2 kg/dunum humic acid and the Tarzek herbicide. In contrast, the lowest value (18.42 cm) was recorded for the Fayyad cultivar without humic acid under the no-weed-control treatment.

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Table 3. Effect of cultivars, humic and weed control method on flag leaf area

Cultivars	Humic	Weed control method				Cultivars rate	Humic rate	Cultivars × Humic
		Without weed control	Hand weeding	Atlantis	Tarzek			
Fayyad	0	18.42 g	31.27 abc	30.65 abcd	30.80 abc	27.35 a	27.95 ab	27.75 b
	1 kg/acre	21.13 efg	25.60 cdef	28.73 abcd	29.83 abcd		26.87 b	26.35 b
	2 kg/acre	18.70 fg	34.3 6ab	30.06 abcd	28.78 abcd		29.63 a	27.97 b
Akja	0	20.33 fg	34.33 ab	29.63 abcd	28.30 abcd	28.95 a		28.15 b
	1 kg/acre	21.26 efg	27.80b cde	31.32 abc	29.29 abcd			27.42 b
	2 kg/acre	23.36 defg	32.80 abc	33.26 ab	35.73 a			31.29 a
Cultivars × weed control method	Fayyad	19.41 b	30.36 a	29.81 a	29.80 a			
	Akja	21.65 b	31.64 a	31.40 a	31.11 a			
Humic x weed control method	0 kg/acre	19.37 c	32.73 a	30.14 ab	29.55 ab			
	1 kg/acre	21.03 c	26.70 b	30.03 ab	29.56 ab			
	2 kg/acre	21.03 c	33.58 a	31.66 a	32.25 a			
Weed control method rate		20.53 b	31.00 a	30.61 a	30.45 a			

Plant height (cm)

The results in Table 4 indicate significant differences between the control treatments and the weed control treatments for the plant height trait. Spraying with Atlantis and Tarzek herbicides recorded the highest mean values, 94.80 cm and 94.98 cm respectively, with no significant differences between them, compared to the no-weed-control treatment, which recorded the lowest value of 87.35 cm. This reduction in plant height under the no-weed-control treatment can be attributed to the high weed density, which increased competition with crop plants and caused shading, thereby restricting growth. These findings are consistent with [14]. Significant differences were also observed between cultivars. The Fayyad cultivar was significantly superior, recording the highest plant height (95.31 cm), followed by the Akja cultivar (91.46 cm). This variation is likely due to physiological and genetic differences between cultivars, which affect their ability to utilize environmental

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conditions and growth factors, leading to enhanced cell elongation. These results agree with [5] and [6]. Regarding humic acid concentrations, the application of 2 kg/dunum resulted in the highest mean plant height (96.12 cm), followed by 1 kg/dunum (93.81 cm), while the control (no humic acid) recorded the lowest value (90.23 cm). The increase in plant height with humic acid application can be attributed to its role in improving nutrient availability, which promotes cell elongation. These findings are consistent with [7] and [9]. For the interaction between cultivars and humic acid concentrations, the combination of the Fayyad cultivar with 2 kg/dunum humic acid recorded the highest plant height (97.30 cm), while the Akja cultivar without humic acid recorded the lowest value (88.00 cm). For the interaction between cultivars and weed control methods, the highest value was recorded for the Fayyad cultivar with Tarzek herbicide (97.07 cm), whereas the Akja cultivar with Tarzek herbicide recorded the lowest (92.90 cm). The interaction between humic acid concentrations and weed control methods showed that 2 kg/dunum humic acid combined with Tarzek herbicide achieved the highest plant height (98.00 cm), while the lowest value (91.76 cm) was recorded for the no-humic-acid treatment with Atlantis herbicide. In the triple interaction among cultivars, humic acid concentrations, and weed control methods, the highest plant height (100.06 cm) was observed for the Fayyad cultivar with 2 kg/dunum humic acid and Tarzek herbicide. The lowest value (83.26 cm) was recorded for the Akja cultivar under the no-weed-control treatment without humic acid.

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Table 4. Effect of cultivars, humic and weed control method on plant height

Cultivars	Humic	Weed control method				Cultivars rate	Humic rate	Cultivars × Humic
		Without weed control	Hand weeding	Atlantis	Tarzek			
Fayyad	0	85.46 ghi	95.66 bcdef	93.20 cdefg	95.50 bcdef	95.31 a	90.23 c	92.45 bc
	1 kg/acre	87.40 hi	103.33 a	99.33 abc	95.66 bcdef		93.81 b	96.18 a
	2 kg/acre	88.13 ghi	102.66 a	98.33 abc	100.06 ab		96.12 a	97.30 a
Akja	0	83.26 i	88.43 ghi	90.33 efghi	90.00 fgh	91.46 b		88.00 d
	1 kg/acre	88.76 ghi	92.33 defg	91.93 defgd	92.76 cdefg			91.45 c
	2 kg/acre	91.10 defgh	96.06 bcde	95.93. bcdef	95.93 bcdef			94.94 ab
Cultivars × weed control method	Fayyad	87.71 d	100.55 a	96.62 b	97.07 b			
	Akja	87.00 d	92.27 c	92.97 b	92.90 c			
Humic x weed control method	0 kg/acre	84.36 e	92.05 cd	91.76 cde	92.75 cd			
	1 kg/acre	88.08 e	97.83 ab	95.13 bc	94.21 bc			
	2 kg/acre	89.61 e	99.36 a	97.50 ab	98.00 ab			
Weed control method rate		87.35 b	96.41 a	94.80 a	94.98 a			

Weight of 1000 grain (g)

The results in Table 5 show that weed control treatments were superior in the 1000-grain weight trait. Atlantis and Tarzek herbicides recorded the highest mean values, 42.12 g and 41.83 g respectively, with no significant differences between them, compared to the no-weed-control treatment, which recorded the lowest value (38.11 g). This improvement is attributed to the efficiency of herbicides in reducing weed density, which contributed to increasing flag leaf height and area, thereby enhancing photosynthetic activity and the translocation of assimilates from the source to the sink, resulting in increased grain weight. These findings are consistent with [3] and [13]. No significant differences were observed between cultivars for the 1000-grain weight trait. However, humic acid application showed a significant effect, as the 2 kg/dunum concentration recorded the highest value (42.76 g), while 0 and 1 kg/dunum recorded lower values (39.79 g and 39.82 g, respectively) without significant differences between them. This increase is likely due to

humic acid's role in enhancing leaf area, improving photosynthesis, increasing nutrient availability and translocation, maintaining leaf vitality, and reducing evapotranspiration, all of which positively influenced grain weight. These results are consistent with [7] and [14]. For the interaction between cultivars and humic acid concentrations, the highest value (43.16 g) was obtained from the Fayyad cultivar with 2 kg/dunum humic acid, while the lowest (39.42 g) was recorded for the Akja cultivar without humic acid. For the interaction between cultivars and weed control methods, the Fayyad cultivar with Atlantis herbicide recorded the highest value (42.67 g), whereas the Akja cultivar without weed control recorded the lowest (37.88 g). Regarding the interaction between humic acid concentrations and weed control methods, the highest value (45.83 g) was recorded for the combination of 2 kg/dunum humic acid with Atlantis herbicide, while the lowest value (36.41 g) was recorded for the no-humic-acid treatment under the no-weed-control condition. In the triple interaction among cultivars, humic acid concentrations, and weed control methods, the highest 1000-grain weight (46.66 g) was obtained from the combination of the Fayyad cultivar with 2 kg/dunum humic acid and Atlantis herbicide, while the lowest value (36.33 g) was recorded for the Fayyad cultivar without humic acid under the no-weed-control treatment.

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Table 5. Effect of cultivars, humic and weed control method on weight of 1000 grain

Cultivars	Humic	Weed control method				Cultivars rate	Humic rate	Cultivars × Humic
		Without weed control	Hand weeding	Atlantis	Tarzek			
Fayyad	0	36.33 b	41.00 ab	41.00 ab	42.33 ab	41.12 a	39.79 b	40.16 a
	1 kg/acre	42.00 ab	41.73 ab	40.36 ab	36.0 b		39.82 b	40.02 a
	2 kg/acre	36.66 b	43.34 ab	46.66 a	46.00 a		42.76 a	43.16 a
Akja	0	36.50 b	38.86 ab	39.66 ab	42.66 ab	40.46 a		39.42 a
	1 kg/acre	38.06 ab	40.66 ab	40.06 ab	39.66 ab			39.61 a
	2 kg/acre	39.10 ab	41.00 ab	45.00 ab	44.36 ab			42.36 a
Cultivars × weed control method	Fayyad	38.33 a	42.02 a	42.67 a	41.44 a			
	Akja	37.88 a	40.17 a	41.57 a	42.23 a			
Humic x weed control method	0 kg/acre	36.41 b	39.93 ab	40.33 ab	42.50 ab			
	1 kg/acre	40.03 ab	41.20 ab	40.21 ab	37.83 b			
	2 kg/acre	37.88 b	42.17 ab	45.83 a	45.18 a			
Weed control method rate		38.11 b	41.10 ab	42.12 a	41.83 a			

Total weight of grain (tons/h)

The results in Table 6 show significant differences among weed control treatments. Atlantis and Tarzek herbicides recorded the highest grain yield values, 2.41 and 2.28 tons/ha respectively, with no significant differences between them, compared to the weedy control, which recorded the lowest yield (1.98 tons/ha). This superiority is attributed to the reduction in weed density and the greater availability of essential growth resources, which enhanced flag leaf area, improved photosynthesis, and increased the accumulation of assimilates from the source to the sink, ultimately raising the total grain weight. These findings agree with [3] and [13]. Significant differences were also observed between cultivars. The Fayyad cultivar was significantly superior, producing the highest yield (2.44 tons/ha), followed by the Akja cultivar (1.99 tons/ha). This difference is likely due to variations in competitive ability against weeds, consistent with the results of [11] and

[10]. As shown in Table 13, humic acid application at 2 kg/dunum significantly increased grain yield, recording 2.33 tons/ha, followed by 1 kg/dunum humic acid, which yielded 2.07 tons/ha. The treatment without humic acid recorded the lowest yield (2.25 tons/ha). This improvement is attributed to the role of humic acid in enhancing nutrient availability in the soil, thereby increasing growth traits such as leaf area and plant height, improving photosynthetic productivity, and consequently increasing yield components and overall grain yield. These results are in agreement with [9] and [10]. For the interaction between cultivars and humic acid, the highest yield (2.71 tons/ha) was obtained from the combination of the Fayyad cultivar with 2 kg/dunum humic acid, while the lowest (1.85 tons/ha) was recorded for the Akja cultivar with 1 kg/dunum humic acid. In the interaction between cultivars and weed control methods, the highest yield (2.65 tons/ha) was recorded for the Fayyad cultivar with Atlantis herbicide, while the lowest (1.77 tons/ha) occurred with the Akja cultivar under the no-weed-control condition. For the interaction between humic acid and weed control methods, the combination of 2 kg/dunum humic acid with Atlantis herbicide achieved the highest yield (2.54 tons/ha), while the lowest (1.91 tons/ha) was recorded for 1 kg/dunum humic acid under the no-weed-control condition. The triple interaction among cultivars, humic acid, and weed control methods revealed that the highest yield (3.09 tons/ha) was produced by the combination of the Fayyad cultivar with 2 kg/dunum humic acid and Atlantis herbicide, whereas the lowest yield (1.40 tons/ha) was recorded for the Akja cultivar with 1 kg/dunum humic acid under the no-weed-control treatment.

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Table 6. Effect of cultivars, humic and weed control method on total weight of grain

Cultivars	Humic	Weed control method				Cultivars rate	Humic rate	Cultivars × Humic
		Without weed control	Hand weeding	Atlantis	Tarzek			
Fayyad	0	1.40 h	2.00 defgh	2.68 abcde	2.73 abc	2.44 a	2.25 ab	2.32 b
	1 kg/acre	2.42 bcdef	2.22 bcdefg	2.18 bcdefg	2.33 bcdefg		2.07 b	2.28 b
	2 kg/acre	2.29 bcdefg	2.69 abcd	3.09a	2.78 ab		2.33 a	2.71 a
Akja	0	2.04 defgh	2.13 bcdefg	2.46 abcdef	2.14 cdefg	1.99 b		2.19 bc
	1 kg/acre	1.40 h	2.22 bcdefg	2.05 cdefgh	1.71 gh			1.85 d
	2 kg/acre	1.87 fgh	1.93 fgh	1.99 efgh	2.00 efgh			1.95 cd
Cultivars × weed control method	Fayyad	2.19 b	2.30 ab	2.65 a	2.61 a			
	Akja	1.77 c	2.09 bc	2.17 b	1.95 bc			
Humic x weed control method	0 kg/acre	1.95 de	2.06 cde	2.57 a	2.43 abc			
	1 kg/acre	1.91 e	2.22 abcde	2.12 abcde	2.02 cde			
	2 kg/acre	2.08 bcde	2.31 abcde	2.54 ab	2.39 abcd			
Weed control method rate		1.98 b	2.20 ab	2.41 a	2.28 a			

Percentage of protein in grains (%)

The results in Table (7) indicate that there were no significant differences among herbicides in terms of grain protein percentage. The Fayyad cultivar was significantly superior in grain protein percentage, recording 13.71%, compared to 13.35% for the Akja cultivar. No significant differences were observed among the humic acid treatments for this trait. For the interaction between cultivars and humic acid, the combination of the Akja cultivar with no humic addition recorded the highest value (13.85%), while the lowest value (13.06%) was recorded for the Fayyad cultivar with humic acid at 2 kg/dunum. Regarding the interaction between cultivars and weed control methods, the Akja cultivar combined with the herbicide Atlantis recorded the highest significant protein percentage (13.87%), whereas the combination of the Akja cultivar with the herbicide Tarzek had the lowest (13.02%). For the interaction between humic acid and weed control methods, the highest value (13.75%) was recorded for the combination of no weed control and

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humic acid at 1 kg/dunum, while the lowest (13.18%) was recorded for humic acid at 1 kg/dunum with the herbicide Atlantis. In the triple interaction among cultivars, humic acid, and weed control methods, the highest value (14.00%) was obtained for the combination of the Akja cultivar, no humic addition, and the herbicide Tarzek, whereas the lowest value (12.76%) was recorded for the Fayyad cultivar with the herbicide Tarzek and humic acid at 2 kg/dunum.

Table 7. Effect of cultivars, humic and weed control method on percentage of protein in grains

Cultivars	Humic	Weed control method				Cultivars rate	Humic rate	Cultivars × Humic
		Without weed control	Hand weeding	Atlantis	Tarzek			
Fayyad	0	13.36 abc	13.80 abc	13.46 abc	13:30 abc	13.71 a	13.67 a	13.48 ab
	1 kg/acre	13.60 abc	14.26 a	13.23 abc	13.00 bc		13.62 a	13.52 ab
	2 kg/acre	13.50 abc	13.23 abc	12.76 c	12.76 c		13.32 a	13.06 b
Akja	0	13.63 abc	13.90 abc	13.90 abc	14.00 ab	13.35 b		13.85 a
	1 kg/acre	13.90 abc	13.90 abc	13.90 abc	13.36 abc			13.71 a
	2 kg/acre	13.23 abc	13.36 abc	13.83 abc	13.86 abc			13.57 ab
Cultivars × weed control method	Fayyad	13.48 abc	13.76 ab	13.15b c	13.02 c			
	Akja	13.58 abc	13.65 ab	13.87 a	13.74 ab			
Humic x weed control method	0 kg/acre	13.50 a	13.85 a	13.68 a	13.65 a			
	1 kg/acre	13.75 a	13.98 a	13.56 a	13.18 a			
	2 kg/acre	13.36 a	13:30 a	13:30 a	13.31 a			
Weed control method rate		13.53 a	13.71 a	13.51 a	13.38 a			

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References

[1] Al-Mashhadani Ahmed Majeed Abdullah (2020) The effect of tillage systems, seed quantities and herbicides on the growth and yield of bread wheat under rain-fed conditions (*Tritcum aestivum* L.) 1.

[2] Al-Huhaibi, Jassim Khader Ali Abdul (2024) The effect of herbicide concentrations on the growth characteristics and yield of bread wheat and its accompanying weeds. Doctoral thesis. Ah. College of Agriculture. Tikrit University.

[3] Al-Hayali, Talal Abdul Khattab, Salah Al-Din Abdul Qader Saleh, and Moataz Mohammed Siddiq (2014) The effect of some herbicides on the accompanying weeds in wheat fields in areas with semi-guaranteed rainfall. Al-Rafidain Journal of Agriculture 42(1), 146-152.

[4] FAO(2022). Food and Agriculture organization of the United Nations, agriculture and consumer protection department, magazine home.

[5] Xu, D.-p., 2017 Natural antioxidants in foods and medicinal plants: Extract assessment and resources. International journal of molecular sciences. 18(1):96,

[6] Li, Y., 2015. Total phen0lic, flavonoid content, and antioxidant activity of flour noodles, and steamed bread made from different colored wheat grains by three milling methods. The crop journal.3(4):328-334

[7] kaur,H singh,G.,singh F,(2020). Dynamics of weeds and their management through herbicide mixtures in wheat (*Tritcum aestivum* .L) crop Res, 55:10-13.

[8] Andrew I. K.S., J. Storky.(2015). Using simulation models to investigate the Cumulative effects of sowing rate, sowing date and cultivar choice on weed competition . I.K.S. Andrew , J. Storkey _ Crop protection 254-259(:4)38.

[9] Musa, Ghada Rajab Musa, (2024). The effect of plant density and humic acid addition on growth characteristics, yield and its components of yellow corn crop (*Zea mays* L.). Master's thesis, Department of Field Crops, College of Agriculture, Tikrit University.

[10] Al-Zubaidi, Najm Abdullah Juma and Adi Salah Mahdi Al-Anbaki. 2019. The effect of adding humic acid and potassium foliar fertilization on the growth and yield of yellow corn. Journal of Diyala University for Agricultural Sciences. 94-86:(11) 1.

[11] Al-Tayf, Mohamed Ramadan Ahmed (2020) The effect of competitive ability of soft wheat cultivars and chemical control of weeds and harmful weeds associated with wheat crop. Arab Journal of Plant Protection,

[12] Taha, Abbas Abdullah (2018), The effect of humic acid and plant density on the growth and yield of two yellow corn

ISSN 2072-3857

cultivars (Zea mays L.). PhD thesis, University of Mosul. College of Agriculture and Forestry. Master's thesis, College of Agriculture and Forestry, University of Mosul.

[13] Salman, Bashar Jassim (2024). The effect of planting distances and herbicides on the growth and yield of bread wheat. Triticum aestivum L.) and its residual effect on the subsequent crop. PhD thesis. College of Agriculture. Tikrit University.

[14] Al-Azzi, Muhammad Hussein Lafta Al-Azzi (2022). The effect of different levels of humic acid and some chemical herbicides on the growth, yield and quality of mung beans.Vigana radiate L. and its associated weeds. Master's thesis, Department of Field Crops, College of Agriculture, Tikrit University.

[15] Al-Salmani, Sinan Abdullah, Adel Hayes Abdul Ghafour, and Noufal Adnan Sabry (2016). The effect of herbicides and planting distances on the yield and its components of wheat crop.Triticum aestivum L. and its associated weeds. Anbar Journal of Agricultural Sciences 14(1). 227-236.

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