Indicators of some growth and productivity traits of some wheat varieties with different plant densities under the influence of residues of *Sorghum halepense* L. and *Xanthium strumarium* L.

Hazem Mohammed Hamid[1], Shaker Mahdi Saleh[2]

[1] Ministry of Agriculture/ Diyala Agriculture Directorate
[2]Tikrit university, college of agriculture, field crops department.
Corresponding author e-mail: hazim.moh.ha720@st.tu.edu.iq
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Abstract

A pilot study was conducted during the winter season (2023–2024) to investigate the effects of residual weeds (*Sorghum halepense L.*) and weeds (*Xanthium strumarium L.*) on some growth and yield characteristics of wheat cultivars and different plant density traits in Diyala Governorate, Al-Muqdadiyah District, within a June-spreading zone. The experiment was conducted in a randomized complete block design (R.C.B.D) with three distinct replicates, 3 independent sub-groups, using three wheat crop varieties (Aba99, Sham6, Al-Fayyadh), preferring the effect of the residues of the two types of weeds, the first (weed (*Sorghum halepense L.*) uses C4 herbaceous plants) used (weed (*Xanthium strumarium L.*) exploits C3 species) and the third factor with the quantity of seeds (40 kg.dun^{-1}, 50 kg.dun^{-1}). The results showed no significant differences between the varieties in the number of seedlings, number of spikes, and harvest index, while the Sham 6 variety was early and gave the lowest number of days to 50% spike bunch, reaching (97.08) days, while the Abaa 99 variety recorded the highest number of days, reaching (101.63) days. The comparison treatment without adding weed residues was superior and recorded the highest average for the total yield trait, which amounted to (4925.0 kg.ha^{-1}), Because of its superiority in the number of total branches (372.83 branch. m^2) and the number of spikes (337.39 spikes. m^2). It also excelled in the harvest index trait, and the treatment of adding C3 weed residues recorded the highest average for the number of days until 50% of the ear cluster, which amounted to (100.17) days. Meanwhile, the seed quantity of 50 kg.dun^{-1} was superior in the number of days to 50% ear development, the total number of seedlings, and the number of earlings, and recorded an average of (100.14 days, 349.50 seedlings .m^2, 312.17 seedlings. m^2) respectively, and there were no significant differences between the seed quantity in the total yield characteristic.

Keywords: Allelopathy, varieties, plant density

Introduction

Wheat (*Triticum aestivum L.*), a member of the Poaceae family, is considered a globally important crop due to its crucial role in achieving food security and bread production. It is a staple food for most of the world's population and is indispensable it is considered a major source of carbohydrates, in addition to its high content of cellulose and protein [1]. Although Iraq is considered one of the original homelands of this crop, its productivity remains below the desired level. The statistics showed that the cultivated areas in the world for the year 2020 amounted to 221,860,000 hectares and produced 775,820,000 tons with an average productivity of 3.50 tons.ha^{-1} [2], while the cultivated areas in Iraq for the year 2020 amounted to 857,400,000 hectares and produced 6,238,000 tons with an average productivity of 2.91 tons.ha^{-1} [3]. Wheat cultivation in Iraq faces major problems, which have led to a significant deterioration in its quality and a reduction in its yield per unit of cultivated area compared to global production. Most of these problems are related to the cultivated variety, crop service operations, soil problems, drought, and incorrect management in weed control, which makes the crop unable to fully exploit its physiological and genetic capabilities [4].

Allelopathy is an important environmental phenomenon in agriculture due to its effective role in natural ecosystems and agricultural systems, as the remains of these plants on the surface of the soil begin to decompose, leading to the release of many phytotoxins that hinder the germination of crop seeds. And the decrease in the growth of seedlings and thus affecting the crop productivity, and studies have shown the existence of a relationship of a biological antagonism phenomenon between weeds and crops or between crop plants themselves, through the release of chemical compounds through the secondary metabolic pathways with a negative effect that works to inhibit the germination process and seedling growth and hinder the absorption of growth requirements as well as affecting the process of photosynthesis. These compounds are produced through secondary metabolism (carbohydrates and proteins) and include terpenes, phenols and alkaloids [5].

The study indicated that there were significant differences between the six varieties included in the study in the number of days to 50% ear cluster, as the Baraka variety gave the lowest number of days, reaching 137.66 days, compared to the Rashid variety, which gave the longest number of days, reaching 143.08 days, while the Tammuz 2 variety recorded the highest average for the total number of tillers and the number of spikes, and the yield reached (478.91 tillers m^{-2}, 430.33 spikes m^{-2}, 3.69 tons ha^{-1}), respectively. While the Baraka variety recorded the lowest averages for these traits, reaching (322.83 stalks m^{-2}, 228.08 spikes m^{-2}, 72.2 tons ha^{-1}) respectively, and the Ibaa 99 variety recorded the highest average for the harvest index trait, reaching (28.82)% [6]. It was found that there were significant differences between the varieties used in the experiment (Adna99, Hawler, Suleimani) in the number of spikes (spike.m2) and the total yield (ton.ha-1). The Hawler variety recorded the highest average for these characteristics, reaching (309.82, 2.49) respectively, compared to the other varieties[7] . [8] explained in a study on six wheat genotypes:(SK94, SK95,

Side12, Side14, Giemiza9, Giemiza7, Al-Fyyad). The superiority of the Giemiza9 genotype in the individual plant yield trait gave the highest average of 67.862 grams. In a study conducted to determine the variance between four varieties of bread wheat at two locations, Jaliukhan and Nimrud, the results indicated the presence of significant differences, as the Buhuth 22 variety outperformed the thousand-grain weight trait at the first location. [9] In his experiment, he found that the hybrid Saber Beyk outperformed the rest of the varieties included in the study, namely Al-Ezz, Al-Aba, Dijlah, Al-Furat, and Al-Intisar, by giving the highest grain yield of 13.37 grams. [10] indicated in the results of his study that there were significant differences between the treatments when adding 6 and 12 grams of the remains of rocket weed (C3) and squill weed (C4) and the treatment of mixing between them in addition to the comparison treatment in the trait of the total number of shoots (shoot.plant^{-1}) and the number of spikes (spike.plant^{-1}) and the total yield (ton.ha^{-1}) and the harvest index (%).The treatment of mixing the two layers at a level of 12 grams recorded the lowest averages, reaching (4.33, 3.35, 2.65, 12.26) respectively, compared to the comparison treatment, which gave the highest averages, reaching (8.56, 6.08, 3.58, 17.0199) respectively. [11] The results of his study indicated the knowledge of the effect of some crop residues, which are the residues and wastes (stems and leaves) of wheat, yellow corn, and sunflower crops, as the wheat residues gave the lowest rates in the trait of the total number of branches (m2), the number of spikes (m2), the total yield (tons.ha-1), and the harvest index (%), as the rates reached (370.11, 348.78, 2.86, 34.66) respectively, compared to the comparison treatment, which gave the highest rates for these traits. . [12] showed that there were significant differences between the seed quantities (100, 140, 180) kg.ha^{-1} in the characteristics of the total number of shoots/sprout/m^2, the number of spikes/sprout/m^2, and the total yield/ton.ha^{-1}, where the seed quantity of 180 kg.ha^{-1} recorded the highest averages, reaching (838.00, 769.40, 5.88), respectively, compared to the seed quantity of 100 kg.ha^{-1}, which recorded the lowest averages. [13] reported that increasing the seed average from 60 kg ha^{-1} to 180 kg ha^{-1}led to a 50% increase in the number of days to ear setting. The aim is to know the allelopathic effect of weed residues on wheat yield and which varieties are more resistant to this effect under different plant density.

Materials and Methods

Location and design of the experiment

The experiment was carried out in Diyala Governorate, Al-Muqdadiyah District, in one of the fields belonging to one of the farmers during the agricultural season 2023-2024 in clay soil, with the aim of knowing the effect of the presence of green group residues (leaves, stems and seeds) for the maturity stage of two types of summer weeds: a thin-leaved weed (*Sorghum halepense L.*) that belongs to carbon tetrahydroponic plants (C4) broadleaf weed (*Xanthium strumarium L.*) follows the tricarbonyl (C3) plants in some growth characteristics and yield indicators of three wheat varieties (Abaa 99, Sham 6, Al-Fayyad) planted at two plant densities (40 and 50) kg.dun^{-1}. A factorial experiment was conducted according to a randomized complete block design

(RCBD) with three replicates, each replicate containing 24 treatments, so the total number of treatments was 72. The area of the experimental unit was (3 m^2) and the distance between one line and another was (20 cm), so we would have 8 lines in each experimental unit, and the distance between each experimental unit was (50 cm) and between one replicate and another was (1.5 m). Planting took place on 11/20/2023, and nitrogen fertilizer was added in two batches, the first with half the recommended amount at planting and the other half a month after planting, with an average of 90 $kg.ha^{-1}$. As for phosphate fertilizer, it was of the triple superphosphate type (P2O5), which was added in one batch before planting, with an average of 240 $kg.ha^{-1}$ [14]. The land was tilled before plowing to reduce weeds growing on the land designated for cultivation. After planting, manual weeding was carried out and irrigation was carried out whenever necessary.

Collecting weed residues and the method of adding.

The remains of *Sorghum halepense L.* and *Xanthium strumarium L.* were collected from different areas near the site of the experiment in Diyala Governorate, Al-Muqdadiyah District, with an area of one square meter from each area of the fields that preceded wheat cultivation, in which these weeds grew naturally without intervention, as the stems, leaves and seeds of the weeds were taken after maturity, each separately for the two weeds before conducting the experiment, it was air-dried, cut into small pieces, and added to the experimental units in fixed quantities to cover the entire area of the experimental unit, amounting to 9 $tons.ha^{-1}$ [15], and mixed well with the soil. The addition of residues was at four levels: (without adding residues, adding weed residues (C4), adding weed residues (C3), adding a combination of weed residues (C4) and ((C3 together).

Trampled Traits and Statistical Analysis

Number of days from planting until 50% of the spikes were set (days)

The number of days the crop took from the date of the first irrigation until 50% of the spikes were set from the plants was calculated for each experimental unit.

Total number of branches (branch. m^2)

The number of active and inactive branches was calculated by randomly throwing a wooden square (m^2) inside each experimental unit and then calculating the number of branches inside the wooden square.

number of spikes (spike m^2)

The number of spikes per square meter was calculated by throwing a wooden square (m2) randomly inside each experimental unit and then counting the number of spikes inside the wooden square.

total yield (kg h^{-1})

The grains collected from one square meter of each experimental unit were separated from the ears and weighed to determine the average grain yield per square meter in grams, which was then converted to kilograms per hectare.

Harvest index (%)

The harvest index is obtained or calculated from the biological yield (straw + grain) and the grain yield (economic yield) by applying the following equation [16].

The results of the factorial experiment were analyzed using a Randomized Complete Block Design (RCBD) with the SAS statistical analysis program. The arithmetic means were compared using Duncan's multiple range test at a probability level of 0.05.

Results and Discussion

The results of Table No. (1) indicated the presence of significant differences between the varieties used in the study for this trait, as the Sham 6 variety was early in the trait of number of days until 50% flowering and recorded the lowest average number of days, amounting to 97.08 days, compared to the Abaa 99 variety, which gave the highest average number of days, amounting to 101.63 days, This is due to the difference in the nature of the varieties and their ability to respond to the length of the photoperiod and temperatures. These results are consistent with what was reached by [5]. The results showed significant differences between the quantities of seeds used in the experiment for the number of days from planting until 50% ear development, where the quantity of seeds 50 kg.dunum^{-1} recorded the highest number of days, reaching 100.14 days, while the quantity of seeds 40 kg.dunum^{-1} achieved the lowest number of days from planting until 50% ear development, reaching 98.31 days, This may be because increasing the seeding medium reduces the light transmitted through the vegetation, which increases auxin production, slows flower induction, and increases the time required for flowering and maturity [8]. There are significant differences between the treatments of adding weed residues in the trait of number of days up to 50% ear set, and this is what the results indicated in Table No. (1), where the treatment of adding weed (*Xanthium strumarium L.*) was superior and gave the highest average number of days from planting up to 50% ear set, which amounted to 100.17 days compared to the comparison treatment without addition, which gave the lowest average for this trait, which amounted to 97.33 days, The reason for the superiority is the increase in concentrations of substances that inhibit physiological processes, especially phenols inside the plant, and this in turn leads to a greater slowdown in crop growth, which was positively reflected in the increase in the number of days compared to the comparison treatment, and these results are consistent with what was stated in [6]. The two-way interaction between the varieties and the seed quantity had significant differences in the trait of the number of days from planting until 50% ear-heading, where the Sham 6 variety outperformed at a seed quantity of 50 kg.dun^{-1} and gave the highest average number of days, reaching 102.64 days, while the Sham 6 variety recorded at a seed average of 50 kg.dun^{-1} the lowest average number of days, reaching 98.09 days. The effect of the two-way interaction was significant between the treatments of adding weed residues and seed quantities on the trait of the number of days from planting until 50% ear emergence, as indicated in Table No. (1), as the treatment of adding weed residues together was superior at a seed quantity of 50 kg.dun^{-1}, achieving the highest

average for this trait, reaching 101.89 days, compared to the comparison treatment without addition at a seed quantity of 40 kg.dun^{-1}, and achieving the lowest average for the number of days from planting until 50% ear emergence, reaching 96.67 days. The results of Table (1) showed that there were significant differences in the interaction between the treatment of adding weed residues and the varieties in the trait of the number of days from planting until 50% of the ear set, as the number of days from planting until 50% of the ear set increased when adding weed (C4) with the Aba99 variety and recorded the highest average of 103.00 days compared to the comparison treatment without adding with the Sham6 variety, which recorded the lowest average number of days, reaching 95.50 days. The triple interaction between the factors included in the study had a significant effect on the number of days from planting until 50% ear production, and this was indicated by the results of the statistical analysis, as the treatment of adding the integration of Daghli together with the Aba 99 variety outperformed at a seed quantity of 50 kg.dun^{-1} and recorded the highest number of days, reaching 104.33 days, while the comparison treatment without adding residues with the Sham 6 variety at a seed quantity of 40 kg.dun^{-1} recorded the lowest number of days, reaching 95.33 days.

Table (1): Effect of varieties, seed quantity, weed residues, and their interaction on the trait of Number of days to 50% ear harvest (day)

varieties	Seed quantity (kg/acre)	weed residues				Interaction between varieties and seed quantity
		Control	*Sorghum halepense*	*Xanthium strumarium*	*Sorghum halepense* + *Xanthium strumarium*	
IPA 99	40	98.33 fg	102.67 bc	102.67 bc	99.00 ef	100.82 b
	50	100.67 de	103.33 ab	102.00 bc	104.33 a	102.64 a
Sham 6	40	95.33 i	95.67 i	96.33 hi	97.33 gh	96.27 d
	50	95.67 i	97.33 gh	99.33 ef	99.67 ef	98.09 c
Al-Fayyad	40	96.33 hi	98.00 fg	100.00 de	98.00 fg	98.36 c
	50	97.67 gh	99.33 ef	100.67 d	101.67 cd	100.09 b
Average weed residues		97.33 b	99.39 b	100.17 a	100.00 a	Average seed quantity (kg/acre)
Seed quantity (kg/acre)		Interaction between seed quantity and weed residues				
40		96.67 c	98.78 b	99.67 ab	98.11 b	98.31 b
50		98.00 b	100.00 a	100.67 a	101.89 a	100.14 a

varieties	Interaction between varieties and weed residues				Average varieties
IPA 99	99.50 d	103.00 a	102.33 ab	101.67 bc	101.63 a
Sham 6	95.50 h	96.50 gh	97.83 fg	98.50 ef	97.08 b
Al-Fayyad	97.00 fg	98.67 ef	100.33 cd	99.83 de	98.96 b
Treatments that have the same letter did not differ significantly from each other at a probability level of 5%.					

Total number of branches (branch.m^2)

The statistical analysis in Table No. (2) showed that there were no significant differences between the varieties in the characteristic of the total number of branches. As for the quantities of seeds, Table No. (2) showed that the quantity of seeds of 50 kg.dun^{-1} was significantly higher, giving the highest average for the total number of branches, amounting to 349.50 branches.m^2, while the quantity of seeds of 40 kg.dun^{-1} gave the lowest average for this characteristic, amounting to 300.00 branches.m^2, this may be attributed to the increase in the number of growing plants, which in turn leads to an increase in the total number of branches per unit area [7]. The results of the statistical analysis showed that there were significant differences between the treatments of adding weed residues in the characteristic of the total number of branches, as indicated in Table No. (2), where the comparison treatment without addition outperformed and achieved the highest average for the characteristic of the total number of branches, amounting to 372.83 branches.m^2, while the treatment of integrating weeds (C4 and C3) together achieved the lowest average for this trait, reaching 289.72 branches.m^2, and the reason for the superiority of the comparison treatment without addition in the trait of the number of effective branches may be that it is free of weed residues, and this gave the crop a greater opportunity to grow without being exposed to the inhibition process Caused by allelopathic compounds resulting from the decomposition of residues such as phenols, glycosides, alkaloids and terpenes, which leads to an increase in the efficiency of the photosynthesis process and its products. This leads to an increase in growth and the formation of more total branches. These results are consistent with [6]. Table No. (2) also showed a positive effect of the two-way interaction between the average seed and the varieties used in the trait of the total number of branches, as the quantity of seeds exceeded 50 kg.dun^{-1} with the Fayyad variety, and the highest average for this trait was recorded, reaching 359.08 branches.m^2, while the quantity of seeds was 40 kg.dun^{-1} with the Aba 99 variety, which recorded the lowest average, reaching 295.60 branches.m^2. The results of the statistical analysis indicated the presence of significant effects of the two-way interaction between the treatment of adding weed residues and the amount of seeds on the total number of branches, as the comparison treatment without adding residues outperformed at a seed amount of 50 kg.dun^{-1} on the remaining treatments, it gave the highest average for the total number of branches, reaching 393.22 branches.m^2, compared to the treatment of adding the merging of the two bushes together at a seed quantity of 40 kg.dun^{-1}, which gave the lowest average

for this characteristic, reaching 261.33 branches.m^2 . The effect of the two-way interaction between the treatment of adding the remnants of the weeds and the varieties on the trait of the total number of branches, as Table (2) showed that the comparison treatment without adding with the Al-Fayyad variety was superior, giving it the highest average for this trait, reaching 384.3 branches.m^2, while the treatment of combining the two remnants of the weeds together with the Sham 6 variety achieved the lowest average for the trait of the total number of branches, reaching 283.7branches.m^2. The triple interaction between the factors included in the study had a significant effect on the total number of branches trait, as the results of the statistical analysis indicated the superiority of the comparison treatment without adding residues with the Fayyad variety at a seed quantity of 50 kg.dun^{-1}, giving it the highest average for the total number of branches trait, amounting to 407.67 branches.m^2, while the treatment of adding the two thickets together with the Abaa 99 variety at a seed quantity of 40 kg.dun^{-1} gave the lowest average for this trait, amounting to (261.33) branches.m^2.

Table (2): Effect of varieties, seed quantity, weed residues, and their interaction on the trait of Total number of branches (branch.m^2)

varieties	Seed quantity (kg/acre)	weed residues				Interaction between varieties and seed quantity
		Control	*Sorghum halepense*	*Xanthium strumarium*	*Sorghum halepense* + *Xanthium strumarium*	
IPA 99	40	352.44 e	283.11 k	303.11 i	261.33 m	295.60 b
	50	393.22 b	329.00 g	357.67 de	318.11 h	347.67 a
Sham 6	40	355.50 de	285.33 k	304.33 i	263.67 m	296.40 b
	50	394.33 b	329.83 g	359.00 d	318.50 h	341.75 a
Al-Fayyad	40	361.00 cd	291.00 j	308.00 i	272.00 l	308.00 b
	50	407.67 a	335.00 f	368.67 c	325.00 g	359.08 a
Average weed residues		372.83 a	306.06 c	330.39 b	289.72 d	Average seed quantity (kg/acre)
Seed quantity (kg/acre)		Interaction between seed quantity and weed residues				

40	352.44 b	283.11 f	303.11 e	261.33 g	300.00 b
50	393.22 a	329.00 c	357.67 b	318.11 d	349.50 a
varieties	Interaction between varieties and weed residues				Average varieties
IPA 99	368.7 b	303.0 ef	327.8 cd	287.0 g	321.63 a
Sham 6	365.5 b	302.2 ef	325.0 cd	283.7 g	319.08 a
Al-Fayyad	384.3 a	313.0 de	338.3 c	298.5 fg	333.54 a
Treatments that have the same letter did not differ significantly from each other at a probability level of 5%.					

Number of spikes (spikelet.m^2)

The data in Table No. (3) showed no significant differences between the varieties in the number of spikes trait. The results of the statistical analysis showed a significant decrease in the number of spikes when weed residues were added, especially when combining the residues of the Johnson Grass weed (C4) and the clotbur weed (C3) together, giving them the lowest average for this trait, which amounted to 260.78 spikes.m^2.While the control treatment without adding residues gave the highest average for this trait, reaching 337.39 spikes.m^2, the reason for this decrease is due to the effect of allelopathic compounds resulting from the decomposition of the residues of both weeds together, which caused negative effects on the leaf area, the accumulation of dry matter, and the insufficiency of manufactured materials that meet the basic requirements of the crop to form the components of the crop. (decrease in photosynthetic efficiency) led to a significant and noticeable competition between the main stems and the tillers in the crop plants, and this was negatively reflected in the total number of tillers and the number of spikes per unit area. These results were consistent with what was found [6]. As the statistical analysis in Table No. (3) showed, there are significant differences between the quantity of seeds in the trait of the number of spikes. The seed quantity of 50 kg. dun^{-1} was superior and achieved the highest average for the number of spikes trait, reaching 312.17 spikes.m^2, compared to the seed quantity of 40 kg. dun^{-1}, which achieved the lowest average for this trait, reaching 267.75 spikes.m^2. The reason for this is that increasing the seed quantity increases the plant density per unit area, which increases the total number of tillers, which is directly proportional to the number of plants bearing spikes, and thus the number of spikes increases. These results are consistent with what was stated in [7]. The two-way interaction between the varieties and the quantity of seeds has a significant effect on the number of spikes trait, and this is what was stated in the data indicated in the table, where the Fayyad variety outperformed with a quantity of seeds of 50 kg.dun^{-1}.The highest average number of spikes was 319.75 spikes.m^2, while the Sham 6 variety recorded the lowest average for this trait at 40 kg.dun^{-1} of seed, reaching 262.20 spikes.m^2. As for the two-way interaction between the treatment of adding weed residues and the number of seeds, the results

indicated the superiority of the control treatment without residues at a seed amount of 50 kg. dun^{-1}. The highest average number of spikes was given, reaching 353.22 spikes.m^2, while the treatment of adding the two weeds together at a seed quantity of 40 kg. dun^{-1} gave the lowest average number of spikes, reaching 237.22 spikes.m^2. The results of the statistical analysis showed that the interaction between the treatment of adding weed residues and the varieties had a significant effect on the number of spikes., that is, there is a significant decrease in the number of spikes when the treatment of adding the remnants of both weeds is combined with the Sham 6 variety, and the lowest average was recorded, reaching 252.30 spikes.m^2, compared to the control treatment without adding residues with the Fayyad variety, which recorded the highest average number of spikes, reaching 344.00 spikes.m^2. The triple interaction between the factors included in the study has significant differences in the trait of the number of spikes. The control treatment without residues with the Fayyad variety at a seed quantity of 50 kg. dun^{-1} recorded the highest average for this trait, reaching 363.00 spikes.m^2, while the treatment of adding the two weeds together with the Sham 6 variety at a seed quantity of 40 kg. dun^{-1} recorded the lowest average number of spikes, reaching 230.00 spikes.m^2.

Table (3): The effect of varieties, seed quantity, weed residues, and the interaction between them on the number of spikes (spike.m^2)

varieties	Seed quantity (kg/acre)	weed residues				Interaction between varieties and seed quantity
		Control	*Sorghum halepense*	*Xanthium strumarium*	*Sorghum halepense* + *Xanthium strumarium*	
IPA 99	40	322.33 e	247.00 n	265.00 l	235.00 p	267.30 b
	50	353.00 b	294.33 h	316.33 f	285.00 i	312.17 a
Sham 6	40	317.33 f	244.67 o	256.67 m	230.00 q	262.20 b
	50	343.67 c	283.33 i	316.67 f	274.67 j	304.58 a
Al-Fayyad	40	325.00 d	254.00 m	269.33 k	246.67 no	273.75 b
	50	363.00 a	302.33 g	320.33 e	293.33 h	319.75 a
Average weed residues		337.39 a	270.94 c	290.72 b	260.78 d	Average seed quantity (kg/acre)
Seed quantity (kg/acre)		Interaction between seed quantity and weed residues				

40	321.56 b	248.56 f	263.67 e	237.22 g	267.75 b
50	353.22 a	293.33 c	317.78 b	284.33 d	312.17 a
Varieties	Interaction between varieties and weed residues				Average varieties
IPA 99	337.67 a	270.70 bc	290.70 b	260.00 cd	289.75 a
Sham 6	330.50 a	264.00 cd	286.70 b	252.30 d	283.38 a
Al-Fayyad	344.00 a	278.20 bc	294.80 b	270.00 bc	296.75 a
Treatments that have the same letter did not differ significantly from each other at a probability level of 5%.					

Total yield (kg.h^{-1})

The results of the statistical analysis indicated that there were no significant differences between the varieties in the total yield. The results in Table (4) also indicated that there were significant differences between the treatments of adding weed residues in the total yield, as there was a noticeable decrease in all treatments of adding residues, especially the treatment of adding a mixture of Johnson Grass weed (C4) and clotbur weed (C3). Which achieved the lowest average for the total yield trait, amounting to 2663.9 kg. h^{-1}, compared to the control treatment, which achieved the highest average for the total yield trait, amounting to 4925.0 kg. h^{-1}. The reason for the superiority of the control treatment without addition in the total yield trait is due to its lack of allelopathic effects, which allowed the wheat crop to grow increasingly in the vegetative and root systems. This matter caused an increase in the area and leaf and thus an increase in the efficiency of the carbon metabolism process and the collection of manufactured materials, which was positively reflected in the grain yield [6]. The results recorded in Table No. (4) also showed that there were no significant differences between the quantity of seeds in the total yield characteristic. There were no significant differences in the two-way interaction between the varieties and the quantity of seeds. This is what the results of the statistical analysis indicated in Table No. (4). The results of the statistical analysis showed that there were significant differences in the two-way interaction between the treatment of adding weed residues and the number of seeds in the total yield trait, as the control treatment without addition was superior at a seed quantity of 50 kg. dun^{-1}, giving it the highest average for the total yield trait, which amounted to 5011.1 kg. h^{-1}. While the treatment of adding both weed residues together at a seed quantity of 40 kg. dun^{-1} gave the lowest average for this trait, reaching 2600.0 kg. h^{-1}. As for the effect of the interaction between the treatment of adding weed residues and the varieties on the grain yield trait, the table indicated the presence of significant differences in the total yield trait between the treatments. The control treatment

without adding residues with the Fayyad variety outperformed by giving the highest average for this trait, reaching 5075.0 kg. h^{-1}, while the treatment of adding the two weed residues together with the Iba'a 99 variety recorded the lowest average for the total yield trait, reaching 2550.0 kg. h^{-1}. The triple interaction between the factors included in the study had a significant effect on the total yield trait, and this is what the results indicated. The control treatment without adding residues outperformed the Fayyad variety at a seed quantity of 50 kg. dun^{-1} and gave the highest average for the total yield trait, reaching 5183.3 kg. h^{-1}, while the treatment of adding the two bushes together with the Iba'a 99 variety at a seed quantity of 40 kg. dun^{-1} gave the lowest average for this trait, reaching 2500.0 kg. h^{-1}.

Table (4): The effect of varieties, seed quantity, weed residues, and their interaction on the total yield trait ($kg.h^{-1}$)

varieties	Seed quantity (kg/acre)	weed residues				Interaction between varieties and seed quantity
		Control	*Sorghum halepense*	*Xanthium strumarium*	*Sorghum halepense* + *Xanthium strumarium*	
IPA 99	40	4733.3 d	3033.3 l	3500.0 i	2500.0 p	3442 a
	50	4866.7 c	3150.0 k	4083.3 g	2600.0 o	3675 a
Sham 6	40	4816.7 c	3083.3 l	3766.7 h	2633.3 o	3575 a
	50	4983.3 b	3200.0 k	4350.0 f	2750.0 n	3821 a
Al-Fayyad	40	4966.7 b	3150.0 k	4100.0 g	2666.7 o	3721 a
	50	5183.3 a	3300.0 j	4583.3 e	2833.3 m	3975 a
Average weed residues		4925.0 a	3152.8 c	4063.9 b	2663.9 d	Average seed quantity (kg/acre)
Seed quantity (kg/acre)		Interaction between seed quantity and weed residues				
40		4838.9 b	3088.9 f	3788.9 d	2600.0 h	3579 a
50		5011.1 a	3216.7 e	4338.9 c	2727.8 g	3824 a
Varieties		Interaction between varieties and weed residues				Average varieties

IPA 99	4800.0 b	3091.7 g	3792.0 e	2550.0 i	3558 a
Sham 6	4900.0 ab	3141.7 f	4058.0 d	2691.7 h	3698 a
Al-Fayyad	5075.0 a	3225.0 f	4342.0 c	2750.0 h	3848 a
Treatments that have the same letter did not differ significantly from each other at a probability level of 5%					

Harvest index (%)

The results of the statistical analysis showed that there were no significant differences between the varieties in the harvest index trait, and this is what the results of the statistical analysis indicated in Table No. (5). It also showed that there were no significant differences between the seed quantities in the harvest index trait. The results of the statistical analysis mentioned in Table No. (5) indicate the presence of significant differences between the treatments of adding weed residues in the harvest index trait, as the comparison treatment without addition was superior and gave the highest average for the harvest index trait, amounting to 34.66%. While the treatment of adding the two residues of the two weeds (C4 and C3) together achieved the lowest average for this trait, which reached 22.33% [6]. The results also showed that there were no significant differences in the two-way interaction between the quantity of seeds and the varieties in the harvest index trait. The interaction between the treatment of adding weed residues and the amount of seeds had a positive effect on the harvest index trait, as the comparison treatment without addition was superior at the amount of seeds of 50 kg.dun^{-1} and recorded the highest percentage of the harvest index trait of 34.85% compared to the treatment of adding the two weeds together at the amount of seeds of 40 kg.dun^{-1}, which gave the lowest percentage of this trait of 21.93%. The data in the table showed a positive effect of the two-way interaction between the treatments of adding weed residues and the varieties on the harvest index trait, as the results indicated the superiority of the comparison treatment without adding residues with the Al-Fayyad variety, giving it the highest percentage for this trait, reaching 35.43%. While the treatment of adding the two remnants of the two thorns together with the Ibaa variety gave the lowest percentage of the harvest index trait, which amounted to 21.64%. The triple interaction between the factors included in the study had significant differences in the harvest index trait, as the comparison treatment without adding remnants with the Al-Fayyad variety outperformed at the seed quantity of 50 kg.dun^{-1} and gave the highest average of the harvest index trait, which amounted to 35.79%. While the treatment of adding the two remnants of the two bushes together with the Aba 99 variety at a seed quantity of 40 kg.dun^{-1} gave the lowest average for this trait, reaching 21.40%.

Table (5): The effect of varieties, seed quantity, weed residues, and their interaction on the Harvest index (%)

varie-ties	Seed quantity (kg/acre)	weed residues				Interaction between va-rieties and seed quantity
		Con-trol	*Sorghum halepense*	*Xanthium stru-marium*	*Sorghum halepense* + *Xanthium stru-marium*	
IPA 99	40	33.98 d	24.80 l	27.13 j	21.40 p	26.83 a
	50	34.03 d	24.68 l	30.06 h	21.88 o	27.66 a
Sham 6	40	34.41 c	24.73 l	28.94 i	22.28 n	27.59 a
	50	34.71 bc	24.90 l	31.63 f	22.98 m	28.56 a
Al-Fay-yad	40	35.06 b	25.05 l	31.02 g	22.11 n	28.31 a
	50	35.79 a	25.52 k	33.17 e	23.32 m	29.45 a
Average weed residues		34.66 a	24.95 c	30.33 b	22.33 d	Average seed quantity (kg/acre)
Seed quantity (kg/acre)		Interaction between seed quantity and weed residues				
40		34.48 a	24.86 d	29.03 c	21.93 e	27.58 a
50		34.85 a	25.03 d	31.62 b	22.73 e	28.56 a
Varieties		Interaction between varieties and weed resi-dues				Average vari-eties
IPA 99		34.01 b	24.74 f	28.60 e	21.64 h	27.24 a
Sham 6		34.56 ab	24.82 f	30.28 d	22.63 g	28.07 a
Al-Fayyad		35.43 a	25.28 f	32.09 c	22.72 g	28.88 a
Treatments that have the same letter did not differ significantly from each other at a probability level of 5%						

From the results obtained, we conclude that the Fayyad variety is superior in some of the studied traits. The results showed that the combination of the two weed residues

harmed most traits compared to the control treatment. It is recommended that the Fayyad variety be adopted and planted in the area where the experiment was conducted, given its superiority and resistance to secondary metabolites resulting from the decomposition of weed residues.

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