Effect of six herbicides to control the wild barley and other weeds accompanied with wheat

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Abstract. A field experiment was carried out in the fields of one of the farmers in the province of Wasit Al-Ahar area during the agricultural season 2015-2016 to control the wild barley and other weeds accompanied with the wheat. The experiment included six herbicides (Sulfon using 50 g.h\(^{-1}\), Granysam with 15 g.h\(^{-1}\), Granysam at the rate of use of 25 g.h\(^{-1}\), Bonanza rate of use of 100 g.h\(^{-1}\), Bonanza rate of use of 125 g.h\(^{-1}\) and 2,4 - D use rate of 1320 ml. h\(^{-1}\)) and the treatment of weedy. Sulfon, Bonanza 100 g.h\(^{-1}\) and Bonanza 125 g.h\(^{-1}\) herbicides affected significantly in reduced of weeds number of narrow leaves and its decreasing dry weight. While Sulfon, Granysam at a rate of 15 g.h\(^{-1}\), Granysam at a rate of 25 g.h\(^{-1}\) and 2,4-D in reducing weeds number of broad leaves and Its decreasing dry weight. The effect of herbicides in reducing the number of weeds and inhibiting their growth was reflected in a significant increase in the characteristics of the biological yield and the harvest index. The herbicides treatments gave average of grain yield values 6.10, 5.28, 5.60, 5.55, 5.63, and 5.17 ton.h\(^{-1}\). average of biological yield values 14.17 , 13.37, 13.23, 13.27, 13.8 and 12.93 ton.h\(^{-1}\), harvest index 43%, 40%, 42%, 42%, 41% and 40% respectively. It is concluded that the increase in grain yield with Sulfon was higher than the increase in other herbicides, due to the effect of this herbicides on a certain percentage on the broad weeds as well as its effect on the narrow weeds. This shows that the two-effect herbicides have a more positive result in increasing the yield . The efficacy of Bonanza herbicide affects reducing of wheat hight by a small percentage. The efficacy of Bonanza herbicide and Sulfon herbicide in control wild barley the numbers of weeds and its dry weight as well as their effect on the leaves narrow weeds. Granysam and 2,4-D had an effective effect in reducing the number and dry weight of the broad-leaf weeds.

1. Introduction
Wheat is one of the most important field crops at all, and this crop suffers from attacking pests. Among the most important is the presence of the accompanying weeds, which lead to a large loss of crop yield when not controlled. Weeds plants are highly hazardous when they have a competitive ability to reduce or eliminate the presence of adjacent plants by acquiring available nutrients or releasing them to other plant growth inhibitors [13]. That the addition of herbicides in the late stages of plant growth does not affect the reduction into the number and dry weight of weeds plants ( broad and narrow dry leaves), which necessarily increase the ability of the weeds in competition with wheat crop plants and thus reflected severe competition negatively in reducing the yield [6]. The critical duration of the weeds competition for wheat crop is 30 to 60 days after planting, and there is no economic benefit from controlling the weeds after 60 days of cultivation [4]. The frequent use of herbicides has led to the emergence of resistant generations of weed plants, on the other hand, the
wheat crop needs 45 days without competing with the weeds to grow in a way that makes it more competitive with the weeds later and ensuring a high yield [19]. The plants of weed belong to many families. The families Asteraceae, Poaceae, Brassicaceae and Fabaceae are the most important plant families that pose a threat to different crops around the world [17]. A number of herbicide-resistant weeds have emerged in Iraq in recent years. Among these are the wild barley (Abu Sweef), which is resistant to all the herbicide s used to controlling it earlier due to the great physiological proximity between it and the wheat crop. The aim of the experiment was to controlling the wild barley accompanied with the wheat crop, as well as the other accompanying weeds.

2. Materials and Methods
A field experiment was carried out in the fields of one of the farmers in Wasit province, Al-Ahrar region within of the national program for the development of wheat growing in Iraq / Ministry of Agriculture during the agricultural season 2015-2016 to control the wild barley and other weeds accompanied with wheat. The soil of the experiment plowed two orthogonal plows with the plow and was softened by the disk compass and then settled the ground with the leveling machine. Used the Randomized Complete Block Design of (RCBD) with three replicates. The experimental unit area was 30 m² (6 m * 5 m). The experiment was planted at a rate of 35 kg. The experiment was grounded in the first irrigation on 25/11/2015, and irrigation continued whenever needed. The experiment included Sulfon with an rate use of 50 g.h⁻¹ and Granysam at a rate of 15 g.h⁻¹ and Granysam at a rate of 25 g.h⁻¹ and Bonanza at a rate of 100 g.h⁻¹ and Bonanza at 125 g.h⁻¹ and 2, 4-D at an rate use of 1320 ml.h⁻¹ as well as weedy treatment. Table 1 showing the common and trade names of herbicides used. A back filter was used based on the use of 400 liters.h⁻¹ of water, sprayed the herbicides after planting at 4-5 stage leaves.

2.1. The weeds species were diagnosis (Table 1).

2.2. Calculated numbers of weeds using a wooden square of 1 m² [3].

2.3. Control percentage% (Table 2).

2.4. At the harvest, the weeds was cut from the soil surface level of each experimental unit to one square meter, placed in a paper bag, punctured and air-dried and then weighed. The percentage limits for reducing the number of weeds were calculated as in the equation used by (23).

\[
\text{Control \%} = \left( \frac{\text{Number of weeds in weedy} - \text{number of weed in control}}{\text{Number of bush in comparative treatment}} \right) \times 100
\]

2.5. Percentage of inhibition to dry weight of the weeds was calculated using the following equation (9).

\[
\text{Inhibition \%} = 100 - \left( \frac{A}{B} \times 100 \right)
\]

As:
A = dry weight of the weeds in the control treatment.
B = dry weight of the weeds in comparison treatment.

2.6. the height of the plant (cm), were calculated by counting the height from the surface of the soil to the tip of the spike.

2.7. the number of spikes per square meter.
2.8. The number of grains per spike by counting the number of grains for 10 spikes of each experimental unit.

2.9. Weight of 1000 grain.

2.10. Grain yield was determined to one square meter and then, it was converted to a ton per hectare.

2.11. The biological yield was determined by cutting the crop plants at the level of the soil surface to one square meter and the total weight of the plant (straw + grain) to obtain the biological yield, and then threshing the plants for the weight of the grains for each sample and then about the weight per ton.h⁻¹.

2.12. The harvest index was then extracted according to the equation:

\[ \text{Grain yield} \times 100 \]

\[ \text{biological yield} \]

The data were statistically analyzed in the variance analysis method, using the least significant difference below the 5% probability level [27].

**Table 1.** common and Trade names, chemical formula and the nature of the effect of herbicides.

| Common Name | Trade Name | Rate of use / commercial substance | Type of affected weeds |
|-------------|------------|-----------------------------------|------------------------|
| Sulfosulfouran 75%WDG | Sulfon | 50 g.h⁻¹ | The narrow weeds and some Broad weeds of leaves. |
| Tribenuron Methyl 75%G | Granysam | 15 g.h⁻¹ | Broad-leaf weeds in the fields of wheat. |
| Tribenuron Methyl 75%G | Granysam | 25 g.h⁻¹ | Broad-leaf weeds in the fields of wheat. |
| Sulfo Sulfuron 75%WG | Bonanza | 100 g.h⁻¹ | The narrow weeds in the fields of wheat. |
| Sulfo Sulfuron 75%WG | Bonanza | 125 g.h⁻¹ | The narrow weeds in the fields of wheat. |
| 2,4-D Dimethyl amine salt 75%SL | 2,4-D | 1320 (ml.h⁻¹) | Broad-leaf weeds in the fields of wheat. |

3. Results and discussion

3.1. Types of weeds

In the experimental fields, there are various types of fine and broad weeds. The Poaceae family comes first with respect to the number of species. Table 2. the types of weeds accompanied with Wheat in these experiment.

**Table 2.** Names of weeds scattered in the experiment.

| Narrow-leaves weeds | Broad-leaves weeds |
|---------------------|--------------------|
| **Scientific name** | **Family** | **Scientific name** | **Family** |
| *Hordeum bulbosum* L. | Poaceae | *Milletus indicus* L. | Fabaceae |
| *Avena fatua* L. | Poaceae | *Malva praviflora* | Malvaceae |
| *Lolium rigidum* Gau. | Poaceae | *Ammi majus* L. | Umbelliferae |
| *Lolium temulentum* L. | Poaceae | *Sinapis arvensis* L. | Brassicaceae |
| *Phalaris minor* L. | Poaceae | | |
3.2. Numbers of weeds and Control percentage

The results are in Table 3, indicated that Sulfon, Bonanza by use rate 100 g.h⁻¹ and Bonanza by use rate 125 g.h⁻¹ were superior with full effect into the total number of narrow-leaf weeds in the experiment with 0.0 plant.m⁻² and 0.0 plant.m⁻² and 0.0 plant.m⁻² respectively. And control percentage were 100%, 100% and 100%, compared to weedy treatment that gave the highest average number of high-scoring weeds value 40.3 plant.m⁻². These result was agreed with [6; 18; 7] necessarily lead to a reduction in the number of target weeds and a varying control percentage depending on the type of herbicide and weeds. The results of the table also show the significant effect of the Sulfon and Bonanza 100 g.h⁻¹ and Bonanza 125 g.h⁻¹ decreasing into number the wild barley weed at 0.7, 0.0 and 0.0 plant.m⁻² with control percentage 92, 100 and 100 respectively, compared to the weedy treatment, which gave an average of wild barley value 9.0 plant.m⁻². The results were consistent with [24], which showed a decrease in the number of wild barley when using some mixtures of herbicides with wheat. The results of Table 3 indicate that there is a significant superiority of Sulfon, Granysam in the rate of using 15 g.h⁻¹, Granysam at a rate of 25 g.h⁻¹ and 2,4-D with decreasing into number of broad-leaf weeds at average 10.7, 1.7, 1.0 and 1.0 plant.m⁻², with control percentage 46%, 92%, 95% and 95% respectively, by compared with the weedy treatment, which gave the highest average number of weeds of 20.0 plants. These results have been agreed with [5; 11; 1; 28; 14].

Table 3. Average number of weeds plant.m⁻² and control percentage to the narrow-leaf weeds, broadleaf weeds and wild barley.

| Herbicides       | Leaves Narrow | control % | wild barley | control % | Leaxes Broad | control % |
|------------------|---------------|-----------|-------------|-----------|-------------|-----------|
| Sulfon           | 0.0           | 100       | 0.7         | 92        | 10.7        | 46        |
| Granysam 15 g.h⁻¹| 34.3          | 42        | 9.3         | 0         | 1.7         | 92        |
| Granysam 25 g.h⁻¹| 36.7          | 14        | 8.3         | 8         | 1.0         | 95        |
| Bonanza 100 g.h⁻¹| 0.0           | 100       | 0.0         | 100       | 16.3        | 18        |
| Bonanza 125 g.h⁻¹| 0.0           | 100       | 0.0         | 100       | 15.0        | 25        |
| 2,4-D            | 36.3          | 8         | 8.7         | 3         | 1.0         | 95        |
| Weedy            | 40.3          | 9.0       | 20.0        |           |             |           |
| L.S.D. 0.05      | 6.55          | 11        | 2.1         | 14        | 5.2         |           |

3.3. Dry weight of the weeds and % inhibition percentage

The results of Table 4 showed significant superiority of Sulfon and Bonanza 100 g.h⁻¹ and Bonanza 125 g.h⁻¹ in achieving the lowest average dry weight of the narrow-leaf weeds of 0.0, 0.0 and 0.0 g.m⁻² with a 100%, 100% and 100% inhibition percentage, respectively, compared with the weedy treatment, which gave the highest average 143.3 g.m⁻². Broad-leaf weeds, there is a significant superiority of Sulfon, Granysam 15 g.h⁻¹, Granysam 25 g.h⁻¹ and 2,4-D into gave lowest average to dry weight of the weeds was 183.0, 36.7, 30.7 and 12.0 g.m⁻² and with an inhibition percentage of 29%, 86%, 88% and 95% respectively, compared with the weedy treatment, which gave the highest average dry weight of the weeds at 260.0 g.m⁻². These results were agreed with [1; 20; 12] while not in agreement with [26; 28].
| Herbicides | Leaves  | inhibition | wild   | inhibition | Leaves  | inhibition |
|------------|---------|------------|--------|------------|---------|------------|
|            | Narrow  | %          | barley | %          | Broad   | %          |
| Sulfon     | 0.0     | 100        | 4.1    | 89         | 183.0   | 29         |
| Granysam15 g.h⁻¹ | 137.3 | 4          | 35.5   | 6          | 36.7    | 86         |
| Granysam25 g.h⁻¹ | 133.3 | 6          | 35.6   | 6          | 30.7    | 88         |
| Bonanza100 g.h⁻¹ | 0.0   | 100        | 0.0    | 100        | 224.7   | 17         |
| Bonanza125 g.h⁻¹ | 0.0   | 100        | 0.0    | 100        | 233.7   | 10         |
| 2,4-D      | 126.7   | 11         | 36.3   | 4          | 12.0    | 95         |
| Weedy      | 143.3   |            | 37.8   |            | 260.0   |            |
| L.S.D. 0.05| 19.6    | 21.6       | 5.3    | 17         | 38.5    | 12         |

### 3.4. The height of the plant

The results of Table 5 show that the Bonanza herbicide has significantly reduced plant height for its both rates. Bonanza 100g.h⁻¹ and Bonanza 125 g.h⁻¹ gave plant height was average 97.13 cm and 96.07 cm, respectively. While Sulfon and Granysam 25 g.h⁻¹ gave average height of plant was 99.13 cm and 99.13 cm, while there were no significant differences with the weedy treatment, which gave the average height of the plant was 98.13 cm. The reducing in plant height with the Bonanza herbicide may be due to the effect of this herbicide in the family plants of Poaceae, despite the fact that it was elected for the wheat crop, but reduced its height.

### 3.5. The number of spikes per square meter

The results of Table 5. indicate that there is no significant difference in the number of spikes between all herbicide treatments and weedy treatment (comparison) although there is a clear biological yield increase between herbicide treatments relative to the comparison with weedy treatment.

### 3.6. Number of grains for spike

The results in Table 5 showed a significant increase in all herbicide treatments (Sulfon, Granysam 15 g.h⁻¹, Granysam 25 g.h⁻¹, Bonanza 100 g.h⁻¹, Bonanza 125 g.h⁻¹ and 2,4-D) average number of grains for spike were 47.1, 47.1, 48.1, 50.3, 49.9 and 49.9 grain.spike⁻¹ respectively, compared to the weedy treatment, which gave average of 41.0 grain.spike⁻¹, due to the significant increase of these characteristic may attribute in herbicide treatment to reduced the competition between crop and weeds, which enabled the crop to competition from different growth requirements (nutrients, light, water, and Space) due to the effect of herbicides into reducing the number and the dry weight of weeds (Table 3 and 4). These results do not agree with some that findings of [1; 20; 12], which showed a significant increase in the number of grains of spike when using some weed herbicides, While there is no significant difference with other herbicides, although the control percentage of both groups of herbicides is equal.

### 3.7. Weight of 1000 grains

The results of Table 5 indicate that there are no significant differences in weight of 1000 grain between the treatments of all herbicides compared with weedy treatment, and may be due to the fact that these is genetic characteristic more than the environmental link, and these is contrary to what [8] with an increase weight of 1000 grain due to the use of herbicides.

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**Table 4.** Dry weight of weeds and the percentage of inhibition of the narrow-leaf weeds, broad-leaf weeds and wild barley.

| Herbicides | Leaves  | inhibition | wild   | inhibition | Leaves  | inhibition |
|------------|---------|------------|--------|------------|---------|------------|
|            | Narrow  | %          | barley | %          | Broad   | %          |
| Sulfon     | 0.0     | 100        | 4.1    | 89         | 183.0   | 29         |
| Granysam15 g.h⁻¹ | 137.3 | 4          | 35.5   | 6          | 36.7    | 86         |
| Granysam25 g.h⁻¹ | 133.3 | 6          | 35.6   | 6          | 30.7    | 88         |
| Bonanza100 g.h⁻¹ | 0.0   | 100        | 0.0    | 100        | 224.7   | 17         |
| Bonanza125 g.h⁻¹ | 0.0   | 100        | 0.0    | 100        | 233.7   | 10         |
| 2,4-D      | 126.7   | 11         | 36.3   | 4          | 12.0    | 95         |
| Weedy      | 143.3   |            | 37.8   |            | 260.0   |            |
| L.S.D. 0.05| 19.6    | 21.6       | 5.3    | 17         | 38.5    | 12         |
3.8. Grain yield
The results of Table 5 show significant superiority of all herbicide treatments compared to weedy treatment. Sulfon, Granysam 15 g.h\(^{-1}\), Granysam 25 g.h\(^{-1}\), Bonanza using 100 g.h\(^{-1}\), Bonanza 125 g.h\(^{-1}\) and 2.4-D average grain yield of 6.10, 5.28, 5.60, 5.55, 5.63, and 5.17 ton.h\(^{-1}\), respectively and an increase weedy treatment value 34%, 24%, 28%, 27%, 28% and 22%, respectively with the herbicide treatments compared to weedy treatment gave an average grain yield of 4.03 ton.h\(^{-1}\). The increase came into the value of grain yield in the control treatments (herbicides) to significantly increase with one of the components of yield (grains number into the spike), due to reduced competition for one of the types of fine narrow-leaf weeds or broad-leaf weeds with general treatments except for the treatment of Sulfon, which has an effect on some broad-leaf weeds as well as the specificity of the effect into narrow-leaf weeds. The increase in grain yield of Sulfon that gave highest average of characteristic on others treatments and a significant increase in the treatment of herbicide 2,4-D. This result was agreed with [21; 25; 20; 2; 14; 22].

3.9. The biological yield
The biological yield is also significantly superior in the Sulfon, Granysam treatments 15 g.h\(^{-1}\), Granysam 25 g.h\(^{-1}\), Bonanza 100 g.h\(^{-1}\), Bonanza 125 g.h\(^{-1}\) and 2.4-D as it was given the highest average (14.17, 13.37, 13.23, 13.27, 13.8 and 12.93 ton. h\(^{-1}\) ), respectively compared to the weedy treatment, which gave average (10.93 ton. h\(^{-1}\) ), these results were agreed with [23], which explained that the use of herbicides lead to a significant increase in the biological yield of wheat, whether herbicides are influential in to broad or narrow weeds or both. The effects are almost equal in reducing the dry matter of the wheat crop as a result of the competition for narrow-leaf weeds alone or the competition of the or broad-leaf weeds alone [10].

3.10. Harvest index
As for the harvest index, there was a significant superiority of all herbicide treatments on the weedy treatment. The Sulfon, Granysam 15 g.h\(^{-1}\), Granysam 25 g.h\(^{-1}\), Bonanza 100 g.h\(^{-1}\), Bonanza 125 g.h\(^{-1}\) and 2.4-D (43%, 40%, 42%, 42%, 41% and 40%), respectively compared with the weedy treatment, which gave the lowest harvest index (37%). The treatment of Sulfon significantly superior on the Granysam 15 g.h\(^{-1}\)herbicide and 2.4-D, these results were agreed with [15], who explained that the use of herbicides leads to an inevitable increase in harvest index In the treatment of herbicides, Bromoxynil + MCPA, Fluroxypyr + MCPA, Fluroxypyr + clopyralid + tribenuron, Bromoxynil + MCPA + tribenuron methy, Fluroxypyr + MCPA, Fluroxypyr + clopyralid + MCPA, Clopyralid, Tribenuron + fluroxypyr and Triasulfuron gave a harvest index of 33.74% 38.77%, 39.36%, 37.89%, 33.65%, 36.05%, 35.79%, 33.16%, 34.90% and 43.30% respectively.
Table 5. Effect of plant herbicides into plant height, number of spikes, number of grains, weight of 1000 grains, grain yield, biological yield and harvest index.

| Herbicides | Plant height (cm) | Number of spikes (m²) | Number of grains for spike | Weight 1000 grains | Grain yield (ton.h⁻¹) | Biological yield (ton.h⁻¹) | Harvest Index |
|------------|------------------|-----------------------|---------------------------|--------------------|----------------------|---------------------------|---------------|
| Sulfon     | 99.13            | 418.7                 | 47.1                      | 43.86              | 6.10                 | 14.17                     | 43            |
| Granysam15g.h⁻¹ | 98.27            | 370.7                 | 47.1                      | 43.25              | 5.28                 | 13.37                     | 40            |
| Granysam25g.h⁻¹ | 99.13            | 388.0                 | 48.1                      | 42.55              | 5.60                 | 13.23                     | 42            |
| Bonanza100 g.h⁻¹ | 97.13            | 398.7                 | 50.3                      | 42.24              | 5.55                 | 13.27                     | 42            |
| Bonanza125 g.h⁻¹ | 96.07            | 418.7                 | 49.9                      | 42.74              | 5.63                 | 13.8                      | 41            |
| 2,4-D      | 97.53            | 372.7                 | 49.9                      | 42.60              | 5.17                 | 12.93                     | 40            |
| Weedy      | 98.13            | 364.0                 | 41.0                      | 41.87              | 4.03                 | 10.93                     | 37            |
| L.S.D. 0.05| 1.84             | N.S.                  | 5.4                       | N.S.               | 0.91                 | N.S.                      | 3             |

4. Conclusion
The increase in grain yield with Sulfon was higher than the increase in other herbicides, due to the effect of this herbicide into a particular percentage on broad-leaf weeds, as well as its effect on narrow-leaf weeds. This shows that the two-effect herbicides have a more positive result in increasing the yield. The Bonanza herbicide affects the reduced of plant height by a low percentage. The efficacy of Bonanza and Sulfon into wild barley by reduced the number of weeds and dry weight of weed as well as their effect into narrow-leaf weeds. Granysam and 2.4-D had an effective effect in into reduced the numbers and Dry weight of broad-leaf weeds.

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