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EVALUATION OF THE EFFICIENCY OF SOME HERBICIDESÝ IN THE CONTROL OF BROAD LEAVES ACCOMPANYING BREAD WHEAT (*TRITICUM AESTIVUM* L.) AND ITS EFFECT ON YIELD AND YIELD COMPONENTS

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Abstract

A field experiment was carried out during the 2017/2018 winter season in the Abu Ghraib Research Station, Department of Agricultural Research, Ministry of Agriculture to assess the effectiveness of control broad-leaf weeds growing in the field of wheat variety Buhooth 22. The experiment included use three herbicides, Spotlight 75 DWG (80 g. h^{-1}), 2, 4-D (1330 ml. h^{-1}), and Lintur WG (180 ml.h^{-1}), as well as weedy treatment. The experimental design was a randomized complete block design (RCBD) with three replication. The Lintur herbicide treatment has been achieved the lowest number of weeds (1.3 plant.m^{-2}) with control percent of 94.7%, and reduce the dry weight of the weeds (4.3 gm.m^{-2}) with inhibition percent of 95.2% compared to weedy treatment which recorded the highest average for the number of weeds was 26.7 plants.m^{-2} and the highest average dry weight of weed plants (90.9 gm.m^{-2}). The Spotlight and 2.4-D treatments did not differ significantly from Lintur treatment in weed density, control ratio, weed dry weight, and inhibition percent. The treatment of Lintur WG gave the number of spikes (364.0 sp.m^{-2}), seed per spike (69.33), and 1000 seed weight (36.26 g), which was positively reflected in the increase of grain yield by (68.8%) compared to the weedy treatment. We conclude from the above that all the herbicides used have reduced the number of weeds and their dry weights have been reduced by varying percentages depending on the nature of the chemical composition of the herbicide compared to the comparison treatment and thus increasing the yield and its components.

Key words: Lintur herbicide, Spotlight 75, 2, 4.D

Introduction

Bread wheat (*Triticum aestivum* L.) is considered one of the strategic crops in the world and Iraq because of its importance as a main source of food for more than a third of the world's population. It is ranked first in terms of production and cultivated area as well as its role in economic and social development. Despite its importance in Iraq, the cereal production per unit area is very low than the world production rate. This is due to the failure to follow the scientific methods of cultivation of this crop and the control of agricultural pests, which is a determinant factor in the growth and productivity of the crop and lead to a reduction in the yield of unit area and reduce the quality. The widespread of different types of weeds in the fields of bread wheat in Iraq, especially in irrigated areas and sever competition for this crop is considered as one of the main reasons for the decline in production as the weeds compete crop plants to access water, food, light and other limiting factors to growth, which leads to a decrease in quantity and quality. Several studies indicate that the competition of weeds throughout the season caused a decrease in the wheat yield from 30-50% and sometimes reach more than 70% of the total production according to weed type and their density if not controlled (Ismail, 2002; Chat *et al.*, 2006; Heather *et al.*, 2007). There are more than 16 types of weeds in Iraq, such as *Beta vulgaris, Silybum marianum, Convolvulus arvensis, Raphanus raphanistrum, Polygonum aviculare, Euphorbia peplus, Cephalaria syriaca, Sinapis arvensis, Chenopodium reichenau, Malva parviflora and Ammi majus* (Ismail, 2002). These

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weeds affect the performance of the crop and reduce its productivity, which is due to the high ability to compete with the crop plants to obtain the basic growth elements, as well as the Allelopathy effects of some of them in the production of inhibitory compounds at the root inhibits the growth of the crop. The weeds are also host to many insect pests and cause other pathologies. Therefore, researchers have tended to control these weeds and reduce their risks by using various methods, most important of which are the use of chemical herbicidesý that have achieved significant results in minimizing damage (Steven *et al*., 2010). Many herbicidesý are used in wheat fields to control broad leaf weeds. This method has become the most common in control, which is one of the important agricultural applications currently in reducing competition and increasing crop productivity, because of its high efficiency in the control and selective process and the great specialization against different species of weeds without harming crop plants compared to other methods. The aim of this study is to evaluate the effect of the broad leaf herbicidesý with low utilization rate which has recently been introduced into Iraq, on the associated weed to bread wheat crop and its effect on yield and its components and other characteristics.

Materials and methods

A field experiment was carried out during the 2017/ 2018 winter season in the Abu Ghraib Research Station, Department of Agricultural Research, Ministry of Agriculture, to assess the effectiveness of three herbicides, Spotlight 75 DWG (80 g.h^{-1}), 2, 4-D (1330 ml.h^{-1}) and Lintur WG (45 ml.Donum^{-1}) to control broad-leaf weeds growing in the field of wheat variety Buhooth 22 (Table 1) as well as control treatment (weedy treatment), and its effect on the yield and its components and other traits.

Characters studied

1. Types of the weeds and its density (plant.m^{-2}): After reaching the physiological maturity stage, the existing weeds were counted and diagnosed in the squares method for the area of square meters of each experimental unit (Table 2).

2. Percentage of weed control (%): calculated for different treatments according to the following equation.

Weed control %

$$\frac{No.weed\ in\ weedy\ treatment\ No.weed\ in\ treatment}{No.weed\ in\ weedy\ treatment}$$

3. Dry weight of the weeds at harvest (gm.m^{-2}) and percentage of inhibition: Weeds were cut at the surface level of soil from the area of square meters of experimental unit and placed in perforated bags, then air dried for two weeks with continuous flipping to ensure drying until the weight is stable. The percentage of inhibition of different treatments was calculated according to the following equation.

$$Inhibition\ percent = 100 - \left(\frac{A}{B} \times 100\right)$$

Where A = dry weight of weeds in treatment

B = dry weight of weeds in weedy treatment

4. Plant height (cm): The height of the plant at full ripening stage from the base of the plant to the end of the main spike (end of the spike) is measured without awn the mean of 10 readings.

5. Number of ears. m^{-2}: counted as the number of harvested plants from an area of one square meter of the intermediate lines of each experimental unit.

6. Number of grains. spike^{-1}: The average number

Table 1: The commercial name, common name, active ingredient and rate of use of herbicides used in the experiment.

Commercial name	Active ingredientand concentration	Rate of usePer. h^{-1}	Producingcompany
Lintur WG	Dicamba+Triasulfuron 70	180 gm	Syngenta-Swiss
Spotlight 75 DWG	Tribenuron –Methyl 75%	80 gm	Sineria- Cyprus
MEd amine SL	2,4-D Amine720 gm(w/v)	1330 ml	Midmac- Jordon

Table 2: Names of broad and narrow leaf weeds scattered in the experiment.

English name	Scientific name	Family	Life cycle
Wild beets	*Beta valgaris L.*	Plantaginaceae	Annual
Field Bind Weed	*Convolvolus arvensis L.*	Convolvulacea	Perennial
Milk thistle	*Silybum marianum L.*	Compositae	Annual
Wild safflower	*Carthamus oxyacanthus*	Compositae	Annual
White goosefoet	*Chenopodium album L.*	Chenopodiaceae	Annual
Button weed	*Malva rotundifolia L.*	Malvaceae	Annual
Common Bishop's weed	*Ammi majus L.*	Umbiliferae	Annual

of seeds in 10 spikes per experimental unit after manually threshing, and the number of grains per spike were counted.

7. The weight of 1000 seeds (gm): A random sample taken from harvested sample was collected for each experimental unit. A total of 1000 seeds were counted and then weighed by the electronic balance.

8. Grain yield (ton. h^{-1}): Counted from harvested plants per square meter of each experimental unit. After the hay was isolated from the grain and cleaned well, the grain was weighed and converted to ton per hectare at 14% moisture content.

9. Biological yield (ton.h^{-1}): Counted from harvested plants from the area of square meter of each experimental unit, where the total weight of the plants (grain + straw) and then converted to the weight of ton.hectar^{-1}.

Harvest index (%): Calculated according to following formula:

Statistical analyses

After collecting and tabulating data for all studied traits, statistically analyzed by RCBD using the statistical program Genstat. Means were compared using the least significant difference (LSD) at 5% (Sahooki and Waheeb, 1990).

Results and Discussion

Weed density (plant.m-^{2}), weed control percent (%): During counting and diagnosing broad-leafed weed species associated with wheat crop in weedy treatment (Table 2) scattered in wheat field during growing season, Seven types of broad-leafed weeds were observed, such as Milk thistle, Button weed, Wild beets, Wild safflower, Field Bind Weed, White goosefoot and Common Bishop's weed, were common species in winter crop fields.

The results of Table 3 showed that herbicide treatments were significantly lower the density of the weeds. The Lintur treatment recorded the lowest average number of weeds, with 1.3 plants.m^{-2} at control ratio of 94.7% compared to the weedy treatment which recorded the highest average of 26.7 Plant.m^{-2}. The Spotlight and 2.4-D treatments did not differ significantly from Lintur treatment in weed density and control ratio (Table 3).

Table 3: Effect of herbicides treatments in the density of weeds (plant.m^{-2}), and control percent.

Treatment	No. of weeds (m^{-2})	Control %
Lintur WG	1.3	94.7
Spotlight 75 DWG	2.7	88.3
2, 4-D	2.3	90.7
weedy	26.7	0.0
L.S.D ≤ 0.05	9.23	8.87

Table 4: Effect of herbicide treatments on weed dry weight (gm.m-^{2}) and inhibition percent.

Treatment	Weed dry weightgm.m^{-2}	Inhibition%
Lintur WG	4.3	95.2
Spotlight 75 DWG	9.0	90.1
2,4-D	16.5	81.9
Weedy	90.9	0.0
L.S.D ≤ 0.05	8.03	8.91

The effect of herbicides in increasing the percentage of control may be due to stopping the growth of some types of broad weeds, which are attributed to the effectiveness of herbicides in the elimination of weeds or reduce their growth, which reflected positively in the reduction of their number at high proportion compared to the weedy treatment. These results were in agreement with the results reported by (Mann *et al*., 2007; Shati *et al*., 2011) who confirmed that the use of herbicides leads to a significant reduction in weed density

Dry weight of the weeds (gm.m-^{2}) and the percentage of inhibition%: The effect of herbicidesý on these two traits were in same manner on the density of the weeds. This was evident in the results of Table 4, with the Lintur WG significantly decreasing the dry weight of the weeds (4.3 gm.m^{-2}) at the inhibition percentage (95.2%) compared to the weedy treatment which recorded the highest dry weight of plants (90.9 gm.m^{-2}). The Spotlight and 2.4-D treatments did not differ significantly from Lintur treatment in weed dry weight and inhibition percent.

The dry weight of the weeds shows the high competition between the weed and the crop to extract different growth requirements such as water, light and nutrients, and that dry weight reduction of the weeds gives a clear indication of the effectiveness of these herbicides and their impact on the biological activities of the weeds, and that indicates that herbicides have killed live tissues which perform photosynthesis, that the catabolism has overtaken the process of anabolism in the living tissue of the weeds, thus reducing the accumulation of dry matter, which was positively reflected in the reduction of dry weight compared to the weedy treatment. This result was in agreement with what was found by (Al-Hayyani, 2009; Shati, 2014) with a reduction in the dry weight of the weeds using herbicides.

Plant height:

The results indicated significant differences in plant height when herbicides were used (Table 5). The Lintur WG and Spotlight treatments increased plant height by

8.30% and 2.88%, respectively, compared with weedy treatment that gave the lowest average of the plant height (94.67 cm). This is due to the effectiveness of herbicides in reducing the number of weeds and their dry weights (Table 3 and 4) providing a favorable crop environment to grow without competition for the growth requirements of water, nutrients and light, so photosynthesis has become more efficient and the biological activities of the crop increased by prolonging the internodes, which achieved an increase in plant height. This result was agreed with (Zemer *et al*., 2008; Shati and Lami. 2011; Shati, 2014) who demonstrated that the use of herbicides in weed control of wheat increases plant height, while with (Habib and Alshamma, 2002; Chaudhary *et al*., 2008) found no significant difference in plant height when using herbicides in controlling wheat bushes.

Number of Spikes (m^2):

The results indicated significant differences in number of spikes in m^2 when herbicides were used (Table 5). The Lintur WG and Spotlight treatments increased in spike number per m^2 by 26.96% and 19.39%, respectively, compared with weedy treatment that gave the lowest average of the number spike (286.67 spike.m^2). This is due to the effectiveness of these herbicides in reducing the number of weeds and inhibits their dry weights (Table 3 and 4), which allowed crop plants to grow without environmental stress, especially competition for growth requirements between crop and bushes, thus increasing the efficiency of photosynthesis, which in turn improved the performance of the crop for its vital activities and thus increased the number of spikes in the unit area. This result was agreed with (Khan *et al*., 2000; Chalabi *et al*., 2010) who indicated that the highest number of spikes was achieved in the absence of the competition factor between the crop and the associated weeds and stated that the presence of the competition factor has a clear effect on crop growth and development, and the survival and non-control of the weed during tillering stage is a determining factor in crop growth and production in later stages.

Seed. Spike^{-1}:

The results indicate that the Lintur and Spotlight cultivars have the highest number of seeds per spikes of 69.33 and 68.33 seed, respectively (Table 5), with an increase of 73.3% and 70.83% respectively relative to the weedy treatment which gave the lowest seeds per spike 40.0 seed. This may be due to the effectiveness of the control in reducing the competition of weed for wheat plants and to benefit from the requirements of growth, such as water, light and food with high efficiency and improve the metabolic activities of the plant. This is in agreement with the findings of (Baghestani *et al*., 2006; Shati and Lami, 2011), who noted that the use of herbicides led to an increase in the number of grains in the spike compared to the weedy treatment.

1000 seed weight (gm):

The results showed significant differences in the weight of 1000 grains (g) in the effect of herbicides (Table 5). The treatment of Spotlight and Lintur gave the highest mean weight of 1000 grain at 37.24 and 36.26g respectively. While decrease in the weight of 1000 grains in the weedy treatment (29.75g). Thus, the two treatments increased the weight of 1000 seeds by 25.18% and 21.88%, respectively. This result is due to the availability of a suitable environment for the crop, which has led to the proper growth, which increased the efficiency of photosynthesis, which has been reflected in metabolic activities and benefiting from growth requirements, and the amount that allows him to exploit most of the food available in the composition of grain. Thus, the synthesized substances of the source increased and moved to the sink (seed) and thus reflected in increasing the grain weight. The grain filling stage is in the late stages of crop growth, so the grain weight is affected by the length of filling period and the source's ability to supply photosynthesis products and distributed to the grain as the final sink, since the grain is the ultimate end of these substances, the absence of weed competition or its low numbers and low dry weights (Table 3 and 4) may lead to the supply of the largest amount of water and the primary elements of their representation in the process of photosynthesis by the crop, which directly affects the weight of grain (Chalabi, 2003). This finding is consistent with (Huge *et al*., 2004; Shati, 2014) that the absence of a competition factor between the crop and the associated weeds has a positive effect on weight of 1000 seed.

Grain yield (ton.h^{-1}):

The results showed that the Lintur treatment was significantly higher, giving the highest rate of grain yield of 6.06 tons.h^{-1} with increase of 68.8%, followed by the

Table 5: Effect of herbicide treatments on plant height and yield components.

Treatment	Plant height cm	Spike. m^{-2}	Seed. spike^{-1}	1000 seed weight gm
Lintur WG	102.53	364.0	69.33	36.26
Spotlight 75 DWG	97.40	342.3	68.33	37.24
2,4-D	95.60	309.0	61.33	34.09
Weedy	94.67	286.7	40.00	29.75
L.S.D $\leq$ 0.05	5.553	41.84	3.782	2.304

Spotlight herbicide treatment which reached 5.89 tons.h^{-1} with increase of 64.1% compared to weedy treatment which gave the lowest average of 3.59 tons.h^{-1} (Table 6). This result is due to the growth of wheat plants properly without environmental stress by competing for the requirements of growth such as water, nutrients and light, which increased the efficiency of photosynthesis, which reflected on the biological performance of the crop, which caused an increase in yield components of the crop (spike per unit area, seeds per spike, and 1000 seed weight). Which was positively reflected in the increase of grain yield. This result was agreed with (Al-Hayyani, 2009; Chalabi and Al-Akidi, 2010), who noted that the use of herbicides leads to an increase in grain yield.

Biological yield (ton.ha^{-1}):

The results show the superiority of Spotlight treatment and gave the higher mean of 16.96 tons, h^{-1} with an increase of 23.26%, followed by the treatment of Lintur herbicide which gave 16.58 tons.ha^{-1}, with an increase of 20.49% compared to the weedy treatment, which gave the lowest yield of a total of 13.76 tons.h^{-1} (Table 6). The decrease in biological yield in the weedy treatment may be due to the presence of the competition factor of the weeds, which has clearly affected the growth of the crop and its development and then affect the accumulation of dry matter in different parts of the plant, and that agreed with this finding of (Ali *et al*., 2004; Alvi *et al*., 2004), who pointed out that the use of weed herbicides led to a significant increase in the biological yield compared to the weedy treatment.

Harvest Index (%):

The results indicate that the Lintur treatment was significantly superior and gave the highest average of the harvest index (36.6%), while the weedy treatment recorded the lowest rate of harvest index of 26.1% (Table 6). The effect of herbicides increases the limit of the competition of the weeds for the crop to the different growth requirements as the density of the weeds and their dry weights decreased (Table 3 and 4), thus creating suitable environmental conditions for growth and forming of plants parts that enabled them to achieve an increase in the grain yield higher than the increase in dry matter in comparison with plants in weedy treatment, this result was reinforced with both (Ismail, 2002; Ebadi, 2010) suggesting that the use of weed control had a significant effect on the improvement of vegetative traits, which was reflected in the increase in yield and its components and harvest index as compared to the weedy treatment.

Table 6: Effect of herbicide treatments on grain yield, biological yield, and harvest index.

Treatment	Biological yield (ton.ha^{-1})	yield (ton.ha^{-1})	Harvest index
Lintur WG	16.58	6.06	36.6
Spotlight 75 DWG	16.96	5.89	34.7
2, 4-D	15.92	5.65	35.5
Weedy	13.76	3.59	26.1
L.S.D $\leq$ 0.05	1.882	1.236	6.93

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