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EVALUATION OF THE EFFICIENCY OF BROADLEAF WEED HERBICIDES AT DIFFERENT PLANTING DISTANCES ON WHEAT CROP

Jassim, A. Hayawi *[1] A. S. H. Al-Mafrajy [2] Muhammad, A.W. Taha [3]
*[1]Department Med. Plant Techn. Natural Prod. College of Agricultural Techn. / Mosul. North Techn.
[2]Department. Med. Indust. plants College of Agricultural Al-hawija College of Agricultural Kirkuk
[3]Department. Plant Produc. Techn. College of Agricultural Technol. / Mosul. North Techn. University

ABSTRACT

This study was aimed to evaluation of broad leaf herbicide season 2022/2023 at this research included two factors, the first: weed pesticides with four levels (control, 2, 4-D, Cranstar and Lintor) and with the recommended concentrations for each herbicide. The second: planting distances: which are 15 and 30 cm between the lines. The research was carried out using within factorial experiments complete randomized block design (RCBD), sowing took place on 11/15/2022, with a seeding rate of (100) kg . h^{-1} for Sham 6 cultivar, the herbicides were sprayed by a dorsal sprayer with a capacity of 16 liters on 11/2/2023, and on 3/25/2023 the weed characteristics were studied, and on 5/27/2023 the yield characteristics were studied and the obtained results were summarized as follows: Significant increases in the number of broad weeds, fresh and dry weight of broadleaf weeds at a distance of 30 cm between lines compared with a distance of 15 cm. The distance 30 cm significantly increased the characteristics of plant height and spike length compared with the distance 15 cm. A significant increases in grain yield occurred at the distance 15 cm between the lines compared to the distance 30 cm. The herbicides achieved a significant decreases in the number of broadleaf weeds and their fresh and dry weight compared with the control treatment.

Key words: **plant densities, strategic crop, *Triticum aestivum* L., weed control**

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INTRODUCTION

Wheat crop (Triticum aestivum L.), which belongs to the Poaceae family, Iraq and the world rely heavily on rice as their primary daily food source of the world (Al-Amin etal.. 2015). The wheat crop ranks first in terms of productivity, as global production reached (762.7) tons.ha-1 as reported by the The Food and Agriculture Organization of the United Nations is a global organization dedicated to promoting sustainable agriculture and food production (Chopra etal.,2015). The Central Statistical Organization (Hayawi.2015) indicated that the growing importance of the wheat crop due to the strategic role it plays The increase in wheat productivity is crucial for meeting the growing demand for food security as a result of the increasing population growth (Al-Khafaji etal., 2023) indicated that the wheat crop cereal is a crucial cereal crop that are grown in the northern regions of Iraq depending on the rain in the secured and unsecured areas, and the cultivated area for this crop in Iraq is estimated at about (2143.5) thousand hectares for the winter season 2020, with an increase of its percentage is (35.4)% compared to what it was in the season (2019), which was estimated at (1582.75) thousand hectares. And that productivity reached (6238) thousand tons for the winter season 2020, an increase of (43.6) % over last year's productivity, which was estimated at (4343) thousand tons, with an average yield of (2910.4) kg. ha-1 for the winter season 2020, with an increase of (6)% over the 2019 season, as the yield was estimated at (2744) kg.ha-1,

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(3). Bread wheat is one of the important economic crops that has received the attention of researchers in science in general and Iraq in particular (Said and Jaff .2020; Swanton etal., 2015; Thorsted etal., 2006). Weed plants are one of the most important agricultural pests that affect agricultural production in general, causing great losses in economic crops. The spread of different types of the wheat crop is facing weeds in its fields, and accompanying Fierce the competition for the necessities of life is a significant issue, made it one of the most important reasons for the decline in production in quantity and quality (Hozayn etal., 2012). Weeds are one of the main problems that affect the productivity of many crops when they grow in that field, especially crops that are sensitive to weeds that cause some impactes to the result of competition for growth requirements, which lead to reduced productivity and deterioration the quality of grains (Malik etal.,2012; Mennan etal., .2003) . (Al-Zaidi etal.,2018) indicated that the weeds associated with the wheat crop cause a decrease in yield of up to 30-60 %. It has been customary to use high-efficiency chemical herbicides to eliminate broad-leaved weed plants in wheat fields (Bakht etal.,2007). Mutlag etal., (2023) indicated that weed control with Limitless herbicide led to a reduction in the number of weeds and their dry weight, as well as an increase in the percentage of control, in addition to achieving an increase in the number of spikes, number of grains per spike , and the weight of 1000 grains, which was reflected positively in increasing grain yield, and this result did not differ from the use of the pesticide. Pallas. Including Granstar and Lintur (Al-Ajrawi 2013). The spacing between planting rows significantly influences growth and yield characteristics of the wheat crop, in addition to limiting the growth of weeds (Hayawi etal., 2021) .indicated that he obtained the number of weeds per m-2 and the height of wheat plants increased significantly at a distance 30 cm compared to a distance 15 cm (Al- Harbi. 2021). (Al-Mafarji and Hamad .2015) confirmed when they studied the planting distances 15 and 30 cm between the rows for wheat crop for two consecutive seasons, that the distance 15 cm was significantly superior to the distance 30 cm for many characteristics, including the characteristic of the number of tillers for the wheat crop and the number of spikes is measured in meters per second and grain yield. Use of Atlantis and Balas herbicides to control weeds has achieved the highest number of branches per square meter, weight of a thousand grains, and total grains yield (Jassam etal., 2022).

MATERIALS AND METHODS

The research was conducted at the area of Telkaif, which is located within the semi-curid region during the agricultural season 2022/2023 after preparing the land for cultivation. The research included two factors, the first: herbicides, at four levels (comparison, 2, 4-D, Grstar, and Lintur) and at the recommended concentrations for each herbicide. The second: the planting distances, which are 15 and 30 cm between the lines. The research was carried out using (RCBD) (Al-Badr.2012), sowing took place on November 15, 2022, with a seeding rate of (100) $kg.ha^{-1}$ for Sham (Al-Amin. 2015), In the early morning of 11/2/2023, herbicides were sprayed with a 16-liter noon sprayer. Table (1) shows the commercial and common name, the percentage of the active substance, and the rate of use of the active substance. ha^{-1} . On 3/25/2023, weed samples were taken randomly, at a rate of one square meter from each experimental unit, and classified as in Table (2), and the study examined the number of broad-leaved weeds per m^{-2} and the fresh weight of the weed per m^{-2}, dry weight of the broadleaf weed. m^{-2}, and on 5/27/2023 the following yield characteristics were studied: The study analyzed wheat plant height, spike length, and grain yield using SAS and Duncan's multiple range test to compare averages at the probability level of 0.05

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Table 1. The commercial and common name, percentage of active substance and group of used herbicides

Trade name	Common name	Active substance %	Group	Rate of use of the active substance.ha^{-1}
2,4- D	Dichlorophenol acetic acid	%72	Phenoxy acetic	1.400 ml.ha^{-1}
Granstar	Tribenuron – methyl	%75	Sullfonylurea	11.25 gm.ha^{-1}
Lintur	Triasulfuron + Dicamba	4.1% +65.9%	Amides	84 gm.ha^{-1}

Table 2. English, scientific and family name of the weed spread in the field

English name	Scientific name	Family name
Shepherd purss	*Capsella bursa – postoria*	Brasicaceae
Wild dock	*Raphanus raphanistrum*	Brasicaceae
Wild mustard	*Brassica arvensis*	Brasicaceae
Milk thistle	*Silybum marianum*	Asteraceae

RESULTS AND DISCUSSION

Effect of herbicides and planting distances and the interaction between them on the number of broadleaf weeds (m-2)

The statistical analysis in Table (3) indicates that the distance 30 cm is significantly superior to the distance 15 cm in the characteristic of the number of broadleaf weeds, with an increase of (7.96)%. Perhaps the reason for this is the lack of competition between wees plants and crop plants for moisture, especially when moisture is the determining factor for growth, in addition to the fact that the wide distance gives more space for lighting (Chen etal.,2008). The results also indicate the characteristic has experienced a significant decrease in all the herbicides under study the percentage of decrease was significantly higher compared to the comparison treatment. (90.97, 87.5, 62.85)%. of the three herbicides in a row, and perhaps the reason for this is due to the effectiveness of these herbicides in killing living tissues that come into contact with them, which leads to impeding the growth of these weeds and then their death (Al-Ajrawi 2013). The data indicates that the interaction between the planting distance 15 cm and the herbicide 2.4-D caused the lowest number of broad-leaved weeds to be given, reaching (2.66) weeds, while The study examines the impact of planting distance 15 cm and treatment on the highest number of broad-leaved weeds without herbicide which amounted to 54 weeds. We also the study reveals a significant decrease in the characteristic of all herbicides when planted at a distance of 15 cm compared to 30 cm

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Table 3. Effect of herbicides and planting distances and the interaction between them on the number of broadleaf weeds (m^{-2})

Treats		Herbicides				Effect of distances
		Control	2,4-D	Granstar	Lintur	
Plant distances	15 cm.	54.00 a	2.66 g	4.66 fg	11.66 d	18.25 b
	30 cm.	42.00 b	6.00 ef	7.33 e	24.00 c	19.83 a
Effect of herbicide		48.00 a	4.33 c	6.00 c	17.83 b	

Similar letters mean there are no significant differences at the 5% level

Effect of herbicides and planting distances and the interaction between them on fresh weight of broadleaf weeds (g.m-2)

The results of the statistical analysis in Table (4) indicate that the distance 30 cm between the planting lines was significantly superior to the distance 15 cm in the characteristic of fresh weight of the broadleaf weed, with an increase rate of (29.24) % and perhaps the reason for this is due to the association of this Characteristic in terms of the number of broadleaf weeds, as well as the study found no

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competition for essential life resources between crop and weed plants at a distance of 30 cm compared to 15 cm. which caused this increase in fresh weight of the broadleaf weed (FAO .2020) . And that the use of weed killers was accompanied by a significant decrease in the fresh weight of the broad-leaved the study compares the effectiveness of weed control with a comparison treatment, as the fresh weight of the four treatments was (129.00, 11.00, 16.00, 39.33) g. m-2 in a row. Perhaps the reason for this is due to the high efficiency possessed by these herbicides, which led to stopping the process of biosynthesis of amino acids and proteins, which caused it to obstruct and stop the growth of weed plants compared to the control treatment (without herbicide) (Abouziena etal.,2008). The data indicating significant interaction between the two factors was observed.

decrease in the fresh weight of the broadleaf weed at a distance of 15 cm compared to a distance of 30 cm at each herbicide treatment, including the comparison treatment, and that the interaction between the distance 15 cm and the herbicide 2.4 -D achieved the lowest significant decrease in the fresh weight of the weed, reaching (5.66) g. m-2. As for the highest fresh weight of the broadleaf weed, it was achieved when the interaction between the distance 30 cm and the comparison treatment reached (137.33) g. m-2 .

Table 4. Effect of herbicides and planting distances and the interaction between them on fresh weight of broadleaf weeds (g.m^{-2})

Treats		Herbicides				Effect of distances
		Control	2,4-D	Granstar	Lintur	
Plant distances	15 cm.	120.66 b	5.66 g	10.66 f	18.00 e	38.74 b
	30 cm.	137.33 a	16.33 e	21.33 d	60.66 c	54.75 a
Effect of herbicide		129.00 a	11.00 d	16.00 c	39.33 b	

Similar letters mean there are no significant differences at the 5% level

Effect of herbicides and planting distances and the interaction between them on dry weight of broadleaf weeds (g.m-2)

The data in Table (5) shows the significant superiority of distance 30 cm between planting lines over the distance 15 cm in the dry weight of broadleaf weeds, as the percentage of increase was 30.94 %. Perhaps this is due to the correlation between this characteristic and the number of broad-leaved weeds , fresh weight of broadleaf weeds, in addition to the fact that the wide distance between planting lines gives a greater opportunity for the growth of weed plants compared to the narrow distance that somewhat limits the growth of weeds (Duncan. 1955). Findings indicate that the herbicides used in control achieved a significant decrease in the same characteristic the comparison treatment was compared to the comparison treatment .dry weight of the broad weeds reached (38.33, 2.50, 4.33, 11.50) g for the four treatments, respectively. The reason for this may be due to a decrease in the growth of weed plants. when treated with herbicides (FAO. 2020). The results of the interaction between the workers the table shows a significant decrease in interaction between the distance 15 cm and the herbicide 2,4-D due to the dry weight of the broadleaf weed.was (1.33) g, while the interaction between the distance (Swanton etal.,2015) and the comparison treatment was higher. Dry weight reached 40.33 g. The results of the interaction between the two workers showed a significant decrease in all herbicides, the comparison treatment was conducted at a distance of 15 cm between the lines compared to a distance of 30 cm.

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Table 5. effect of herbicides and planting distances and the interaction between them on dry weight of broadleaf weeds (g.m^{-2})

Treats		Herbicides				Effect of distances
		Control	2,4-D	Granstar	Lintur	
Plant distances	15 cm.	36.33 b	1.33 g	2.33 fg	4.66 e	11.16 b
	30 cm.	40.33 a	3.66 ef	6.33 d	18.33 c	16.16 a
Effect of herbicide		38.33 a	2.50 d	4.33 c	11.50 b	

Effect of herbicides and planting distances and the interaction between them on Height of wheat plant (cm): The results of Table (6) indicate the significant superiority of wheat crop plants planted at a distance of 30 cm between one line and another over those planted at a distance of 15 cm between one line and another in the description of the height of the wheat crop, as the height reached (74.50 and 78.75) cm for the two distances respectively and the reason for this may be due to the increase in the number of plants per line when planting at a distance of 30 cm between one line and another compared to the distance 15 cm when the seeding rate is constant. Some research has indicated a significant increase in plant height at different planting distances. (Al- Rawe and Khalaf Allah .2000 , Chen etal.,2008) . The results show in the same table that the use of herbicides in weed control was accompanied by a significant increase in the height of wheat crop plants, as the height reached (68.33, 84.50, 73.33, 80.33) cm for the four treatments, respectively. (Table 3), which its mentioned means that it lacks competition with the crop for the growth requirements of moisture and nutrients (Al-Anbari etal., 2011). We note that there is a significant difference in this characteristic when the types of herbicides differ among them, and the reason for this may be attributed to the difference in the active substance in these herbicides (Al-Badr.2012). The results of the interaction between the two factors show that the interaction between the distance 30 cm and the 2,4-D herbicide achieved the highest height for wheat crop plants, reaching (86.00) cm, and thus significantly superior to the rest of the interactions, while the lowest height was achieved at the interaction between the distance 15 cm and the comparison treatment, as it reached 66.33 cm. We notice through the interaction that there is a significant increase in the characteristic of plant height at a distance of 30 cm compared to a distance of 15 cm for all herbicides used in control, as well as the comparison treatment, which gives an indication that the first effect was for the distances, followed by the second effect of the herbicides.

Table 6. Effect of herbicides and planting distances and the interaction between them on Height of wheat plant (cm):

Treats		Herbicides				Effect of distances
		Control	2,4-D	Granstar	Lintur	
Plant distances	15 cm.	66.33 e	83.00 b	70.33 d	78.33 c	74.50 b
	30 cm.	70.33 d	86.00 a	76.33 c	82.33 b	78.75 a
Effect of herbicide		68.33 d	84.50 a	73.33 c	80.33 b	

Similar letters mean there are no significant differences at the 5% level

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Effect of herbicides and planting distances and the interaction between them on Spike Length (cm) :

The statistical analysis results have been obtained. in Table (7), shows that the distance 30 cm between planting lines was significantly superior to the distance 15 cm in the characteristic of spike length, with an increase of (21.53)%, and the reason for this may be attributed to the lack of competition between plants when planting. wide distances between the lines compared to the narrow ones, as well as the plants obtaining sufficient lighting at the wide distances, which allows the plants to grow naturally, and this result was identical to what was obtained by each of (Al- Latif. 2022; Choudhary etal., 2016). The results in the same table indicate that the herbicides of 2,4-D and Granstar were significantly superior to the comparison treatment and the herbicide of Lintur in the characteristic of the spike length of the wheat crop, and this result coincided with what was reached (Al-Ajrawi .2013). The results indicate that the interaction between the two factors is significant. The distance 30 cm and the herbicide of 2.4-D, as well as the interaction between the distance 30 cm and the herbicide Granstar significantly outperformed all interactions, as the length of the spike was (10.33) cm. While the interference between the distance 15 cm and the comparison treatment caused the recording of the lowest spike length, which amounted to (7.33) cm. We note that the spike length was significantly higher at the distance 30 cm compared to the distance 15 cm for all herbicides, as well as the comparison treatment.

Table 7. Effect of herbicides and planting distances and the interaction between them on Spike Length (cm)

Treats		Herbicides				Effect of distances
		Control	2,4-D	Granstar	Lintur	
Plant distances	15 cm.	7.33 d	7.66 cd	7.66 cd	7.66 cd	7.58 b
	30 cm.	9.33 ab	10.33 a	10.33 a	8.66 bc	9.66 a
Effect of herbicide		8.33 b	9.00 a	9.00 a	8.16 b	

Similar etters mean there are no significant differences at the 5% level

Effect of herbicides and planting distances and the interaction between them on Grain Yield (g.m^{-2})

Table (8) shows that the productivity of wheat crop increased significantly when the seeds were sown at a distance of 15 cm between one line and another, compared with those sown at a distance of 30 cm. Perhaps the reason for this is due to the homogeneous distribution of wheat crop plants per unit area when the distance between plants is narrow compared to the wide distances when the amount of seeds is fixed (Al-Badr.2012), and this result is similar to what was obtained (Hussian etal.,2022 ; Al-Khalaf etal.2022). And that the use of herbicides to control the broad-leaved weeds accompanying the wheat crop achieved a significant increase in the grain yield, as the yield reached (143.83, 168.16, 164.16, 167.16) g. m^{-2} for the four treatments in a row, and this result was consistent with what was obtained (Fathi etal.,2022).

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Table 8. effect of herbicides and planting distances and the interaction between them on Grain Yield (g.m^{-2})

Treats		Herbicides				Effect of distances
		Control	2,4-D	Granstar	Lintur	
Plant distances	15 cm.	152.00 d	183.33 a	174.66 b	174.33 b	171.08 a
	30 cm.	135.66 e	153.00 d	153.66 d	160.00 c	150.58 b
Effect of herbicide		143.83 c	168.16 a	164.16 b	167.16 a	

Similar letters mean there are no significant differences at the 5% lev

CONCLUSION

Those who indicated that the increase in the yield of the wheat crop is due to the decrease in the number of weeds and their fresh and dry weight, which compete with the crop plants for moisture, especially in the demi-cultivation. As for the interaction between the two factors, the results show that the interaction between the distance 15 cm and the 2,4-D herbicide achieved the highest yield, reaching 183.33 gm. m^{-2}, thus , was significantly superior to all interaction, while the interaction between the distance 30 cm and the comparison treatment had the lowest yield, reaching (135.66) g. m^{-2}.

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

DECLARATION OF FUND

The authors declare that they have not received a fund.

AUTHOR/S DECLARATION

- We confirm that all Figures and Tables in the manuscript are original to us. Additionally, any Figures and images that do not belong to us have been incorporated with the required permissions for re-publication, which are included with the manuscript.
- Author/s signature on Ethical Approval Statement.
- Ethical Clearance and Animal welfare
- Funds:

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تقييم كفاءة مبيدات الادغال عريضة الاوراق عند إختلاف مسافات الزراعة في محصول الحنطة

جاسم عبدالله حياوي[1] عبدالمعين شبيب حمد المفرجي[2] محمد أمين وليد طه[3]

قسم تقنيات النباتات الطبية والنواتج الطبيعية – الكلية التقنية الزراعية – الجامعة التقنية الشمالية[1] قسم النباتات الطبية والصناعية – كلية الزراعة – الحويجة جامعة كركوك[2] . قسم تقنيات الإنتاج النباتي / الكلية التقنية الزراعية / الجامعة التقنية الشمالية[3]

المستخلص

أجري البحث خلال الموسم الزراعي 2022 / 2023 بهدف تقييم كفاءة مبيدات الادغال , وتضمن البحث عاملين الاول : مبيدات الادغال وبأربعة مستويات (المقارنة , الـ D – 4 , 2 و الكرانستار و اللينتور) وبالتراكيز الموصى بها لكل مبيد . الثاني : مسافات الزراعة :وهي 15 و 30 سم بين الخطوط . نُفذ البحث بإستخدام نظام التجارب العاملية وبتصميم القطاعات العشوائية الكاملة الكامل RCBD, تمت الزراعة في 15 / 11 / 2022 وبمعدل بذار (100) كغم . هكتار$^{-1}$ للصنف شام 6 , تم رش المبيدات بواسطة المرشة الظهري سعة 16 لتر في 11 / 2 / 2023 , وفي 25 / 3 / 2023 تمت دراست صفات الادغال , وفي 27 / 5 / 2023 تم دراسة صفات الحاصل وتلخصت النتائج التي تم الحصول عليها بما يأتي : حصول زيادة معنوية في الصفات عدد الادغال العريضة , الوزن الرطب والجاف للأدغال العريضة الاوراق عند المسافة 30 سم بين الخطوط مقارنة مع المسافة 15 سم . حققت المسافة 30 سم زيادة معنوي في صفتي ارتفاع النبات وطول السنبلة مقارنة مع المسافة 15 سم . حصول زيادة معنوية في حاصل الحبوب عند المسافة 15 سم بين الخطوط مقارنة بالمسافة 30 سم . حققت المبيدات انخفاضا معنويا في عدد الادغال عريضة الاوراق والوزن الرطب والجاف لها مقارنة مع معاملة المقارنة .

الكلمات المفتاحية: **الكثافات النباتية، محصول استراتيجي، مكافحة الادغال ، *Triticum aestivum* L. .**