EVALUATION OF HERBICIDES PALLAS AND LIMITLESS IN CONTROLLING THE NARROW AND BROAD LEAVE WEEDS WITHIN WHEAT CROP FIELDS AND THEIR EFFECT ON GRAIN YIELD AND IT'S COMPONENTS

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ABSTRACT

The experiment was conducted at the fields of the Abu Ghraib Research Station's Agricultural Research Department, Ministry of Agriculture during 2018/2019 and 2019/2020 Seasons, this study was aimed evaluation herbicides for controlling narrow and broad weed. The experiment included the use of Pallas OD herbicide, with an application rate of 500 ml. ha^{-1} and Limitless WG with application rate 400 g. ha^{-1} + 500 ml. ha^{-1} activator in addition to free weed treatment and weedy control treatment. A randomized complete block design (RCBD) with three replicates was used. Limitless herbicide treatment achieved the lowest mean number of weeds, which were 1.3 and 2.3 plants. m^{-2} with a control rate of 93.44% and 91.1%, in comparison to the weedy treatment, it decreased the dry weight of the weed (1.97 and 3.22 g. m-2) with an inhibition rate of 88.46% and 87.1% for the two seasons, respectively, which had the most weeds on average, at 22.67 and 28.7 plants. Throughout the two seasons, the weed plants with the highest average dry weight were 19.12 and 24.86 g. m-2. The number of weeds and plants.m^{-2} and the control rate were identical between the control treatments using Limitless and Pallas. The number of grains and spikes increased (by 39.2 and 43.20 percent, respectively) with the Limitless therapy. In comparison to the weedy treatment, spike-1 increased grain productivity by 56.9% and 66.47% for both seasons, with a percentage of 32.7% and 36.08%, weight of 1000 grains at a rate of 27.47% and 24.83%. It can be concluded that weed herbicides with low and high concentrations can be used to kill weeds in wheat fields.

Key words: Biological yield, Harvest Index, Plant height, Inhabitation Ratio.

تقييم كفاءة المبيدين Pallas و Limitless في مكافحة الأدغال الرفيعة والعريضة المرافقة لمحصول الحنطــة وتأثيرها في الحاصل ومكوناته

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المستخلص

نفذت التجربة في حقول محطة أبحاث أبو غريب – دائرة البحوث الزراعية – وزارة الزراعة للموسمين الزراعيين الشتويين 2019/2018 و2020/2019. بهدف تقييم فعالية تأثير مبيدات الادغال الرفيعة والعريضة على الاوراق النامية في حقل حنطة الخبز (صنف بحوث22) تضمنت التجربة استعمال مبيدين Pallas OD بمعدل استخدام500 مل. هـ−1 ومبيد Limitless WG بمعدل استخدام (400 غم. هـ−1+ 500 مل. هـ−1 مادة منشطة) فضلاً عن المعاملة الخالية من الادغال ومعاملة المقارنة (المعاملة المدغلة)، استعمل تصميم القطاعات الكاملة المعشاة RCBD بثلاث مكررات. حققت معاملة المبيد Limitless اقل متوسط لعدد الادغال بلغ 1.3 و2.3 نبات. م−2 وبنسبة مكافحة بلغت 93.44% و91.1% وخفضت الوزن الجاف للأدغال (1.97 و3.22 غم. م−2) وبنسبة تثبيط (88.46 % و87.1%) قياساً الى المعاملة المدغلة التي سجلت اعلى متوسط لصفة عدد الادغال بلغ 22.67 و28.7 نبات. م−2 واعلى متوسط للوزن الجاف لنباتات الادغال بلغ (19.12 و24.86 غم. م−2) ولم تختلف معاملة المكافحة بمبيد Limitless ومبيد Pallas في صفتي عدد الادغال نبات. م−2 ونسبة المكافحة. كما حققت معاملة المبيد Limitlessزيادة في كل من عدد السنابل بلغت (39.2% و43.20%) وصفة عدد الحبوب. سنبلة−1 بنسبة بلغت (32.7% و36.08%) وصفة وزن 1000 حبة بنسبة (27.47% و24.83%) والذي انعكس ايجابياً في زيادة حاصل الحبوب بنسبة بلغت (56.9% و66.47%) ولكلا الموسمين بالتتابع قياساً مع المعاملة المدغلة. يمكن الاستنتاج أنه يمكن استخدام مبيدات الأعشاب بكميات قليلة وتركيزات عالية لقتل الحشائش في حقول القمح.

الكلمات المفتاحية: الحاصل البيولوجي، دليل الحصاد، ارتفاع النبات، نسبة التثبيط

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INTRODUCTION

Bread wheat *Triticum aestivum* L., is one of the most economical important cereal crops that drop the attention of researchers in the world and Iraq (6, 11, 14 , 17). It is the primary source of nutrition for more than one-third of the world's population and ranks first in terms of both production and the amount of land it is cultivated on. The cultivated area was 2,366,000 hectares for the winter season 2021, with an average yield of 2,660 kg. ha^{-1} (18). Although Iraq is one of the wheat origins cultivation and the availability of the main important production factors in such soil, water and appropriate climatic conditions, its productivity is still low compared to the world average and the other developed countries producing this crop (1). This is due to the failure to follow the scientific methods of growing this crop and its management and the control of agricultural pests, the most important of which is the control of weeds, as it is a determining factor in the growth and productivity of the crop and leads to a reduction in the yield per unit area and a reduction in its quality. The grain yield production reduction caused by the weeds in the crop fields may reach 30-50%, and sometimes it reaches more than 70% of the total production amount, depending on the kinds of weeds that are present and their density (8, 13) in the absence of weed control. The excessive use of traditional herbicides with high rates of use for successive years led to the emergence of a kind of resistance to these herbicides by some types of weeds, In addition to the fact that there are several kinds of weeds resistant to the herbicides that are being sprayed, which forced many interested in weed control and herbicide-producing companies to search types of herbicides belonging to different chemical groups with high selective effectiveness and low rate of use for the purpose of using them in weed control and environmental preservation (15, 16), and achieve the highest level in weed control. This study was aimed to evaluate the effectiveness of the effect of low application dose of herbicides, on the weeds of bread wheat and its effect on the grain yield and its components.

MATERIALS AND METHODS

This experiment conducted during the two winter seasons 2018/2019 and 2019/2020 at the field of office of agriculture, MOA at the Abu Ghraib Research Station at the Agricultural Research Department, aimed at evaluating the effect of the effectiveness of Pallas OD herbicide at the rate of use of 500 ml. ha^{-1} and Limitless WG with application rate (400 g. ha^{-1} + 500 ml. ha^{-1} activator) (Table 1), for controlling broad and narrow leaf weeds growing within the fields of bread wheat crop var. Buhooth 22, as well as the control treatment (weedy treatment) and the weed-free treatment and its impact on the yield and its components.The experimental area was ploughed twice perpendicularly using a moldboard plough, smoothed with disc harrows, then levelled with a levelling machine. In order to conduct the experiments, the property was sectioned up into experimental units with dimensions (2×3) with a meter left between one treatment and another. A randomized complete block design (RCBD) was used with three replications. Bread wheat seeds (22) were manually sown at lines of at 20 cm distance between the line, with eight lines for each experimental unit, at a seeding rate of (140 kg ha^{-1}) on 15/11/2018. The plants were harvested on 21/5/2019 for the first season. While the planting date for the second season was on 20/11/2019, and the plants were harvested on 30/5/2020. Urea with 46% nitrogen was used as the fertilizer, and it was given in three batches during the stages of planting, tillering, and stem elongation at a rate of 200 kg ha-1. Contrarily, a plot of land received 120 kg of triple super phosphate fertilizer (46% P2O5) before the soil started to soften (11). The experimental units were irrigated whenever needed, and crop service operations were carried out according to the recommendations followed. The two herbicides were sprayed after germination and at the stage of 2-4 true leaves of wheat crop using a small sprayer (20)L under a pressure of 2.8 kg. cm^{-2} water volume of 400 liter was used as the standard for calibration. ha^{-1}, The spray level was (30-40 cm) above the wheat plants. Weeds were manually removed during the weed-free treatment, whereas in the weedy control treatment, the weeds were allowed to

continue growing alongside the crop throughout the whole growing season.

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

Commercial name	Active ingredient and concentration	Application rate. ha^{-1}	Producing company
Pallas OD	Pyroxsulam45g/ L	500 ml. ha^{-1}	Dow company U.S. A
Limitless WG	Mesosulfuron Methyl 3.0% + Iodosulfuron-Methyl l0.6% + Mefepyer- Diethyl 9.0%	400 g. + 500 ml diffuser	Agri sciences company Turkey

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

English name	Scientific name	Family	Life cycle
Wild oat	*Avena fatua L*	Poaceae	Annual
Lesser canary	*Phalaris minor L*	Poaceae	Annual
Johnson grass	*Sorghum halepense L.*	Poaceae	Perennial
Nutgrass	*Cyperus rotundus* L.	Cyperaceae	Perennial
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

The collected data analysis of variance the means compared using LSD P≤ 0.05 (7, 10).

RESULT AND DISCUSSION

Weed density (plant. m^{-2}) and weed growth percent (%): By counting and classifying the weeds linked with the wheat crop (Table 2) in the weedy treatments and spread in the field during the growing season, it was revealed of eleven types of narrow and broad-leaved weeds and it is of the common types spread in the fields of winter crops. The broad-leaved weeds constituted the largest percentage of the weeds (63.6%) of the total species spread in the field (the weedy control treatment), It was represented by some types: Milk thistle, Button weed, Wild beets, Wild safflower and Common Bishop's weed. While, the narrow-leaved weeds accounted for 36.4%, which was represented by four species: wild oats, Johnson grass, Nutgrass and Lesser canary. The Limitless treatment recorded the lowest average number of weeds, reaching 1.3 and 2.3 plants m-2 with a control rate of 93.44% and 91.1% compared to the weedy treatment, which recorded the highest average of 22.67 and 28.7 plants m^{-2} for both seasons, respectively. These findings demonstrate the effectiveness of weed control methods in reducing weed density (Table 3). The quantity of weeds.m^{-2} and the rate of weed control were the same for the Limitless, Pallas, and weed-free treatments.

Table 3. Effect of control treatments on the number of weed plants. m^{-2} and weed control percentage

Treatment	Application rate	First season		Second season	
		No. of weeds (m^{-2})	control %	No. of weeds (m^{-2})	control %
Limitless	400 g ha^{-1}	1.33	93.44	2.3	91.1
Pallas	500 ml ha^{-1}	3.0	86.45	4.7	83.6
Weedy	Leave weeds throughout the growing season	22.67	0.0	28.7	0.0
Weedy free	Hand weed control	0.0	100	0.0	100
P ≤ 0.05		5.96	8.87	7.01	8.19

The effect of the herbicide in increasing the percentage of control could be due to stopping the growth of some types of broad and narrow-leaved weeds, which are attributed to the effectiveness of the herbicide Limitless and Pallas herbicides in combating the weeds through the mechanism of their effect, which is through preventing the production of ALS

(Acetolactate Synthase), This enzyme forms the essential amino acid chain for cell division, which leads to the death of the weeds. This was reflected positively in reducing their number at a high rate compared to the weedy control treatment. This result agreed with what was indicated by (3, 12, 20, 24) who provided evidence to support the claim that using pesticides significantly reduces the amount of weeds.

Weed dry weight (g.m^{-2}) and inhibition %:

Based on their impact on these two features, herbicides acted in a similar manner when affecting weed density, as shown by the findings in Table 4. Limitless considerably outperformed the weed-containing treatment, which had the highest average dry weight of weed plants for both seasons (19.12 and 24.86 gm. m-2, respectively), in lowering the dry weight of the weeds (1.97 and 3.22 g. m-2 with an inhibition ratio of (88.46 and 87.1%)

Table 4. Impact of control treatments on the percentage of inhibition and the dry weight of weeds.m^{-2}

Treatment	Application rate	First season		Second season	
		Weed dry weight g. m^{-2}	Inhibition %	Weed dry weight g. m^{-2}	Inhibition %
Limitless	400 g ha^{-1}	1.97	88.46	3.22	87.1
Pallas	500 ml ha^{-1}	4.86	77.39	6.98	71.8
Weedy	Leave weeds throughout the growing season	19.12	0.0	24.86	0.0
Weedy free	Hand weed control	0.0	100	0.0	100
P ≤ 0.05		1.703	20.696	1.844	4.77

The low dry weight gives a clear indication of the effectiveness of these herbicides by affecting the vital activities of the weeds and killing the living plant tissues that perform the photosynthesis process, noting that in the living plant tissues of the weeds, the deconstruction process (respiration) functioned better than the construction process (photosynthesis), reducing the accumulation of dry materials. Which is attributed to the effectiveness of both Limitless and Pallas herbicides in affecting the chemical properties of the two herbicides by preventing the production of ALS (Acetolactate Synthase), the primary enzyme that is accountable for creating a chain of essential amino acids, which is required for the process of cell division. Which leads to the death of the weeds, which was positively reflected in the reduction of its dry weight compared to the control weedy treatment. This result in agreement with what was found by (2, 20, 23), that there was a decrease in weed dry weight with the use of herbicides.

Wheat Plant height(cm)

The results show that spraying herbicides caused a significant difference in plant height (Table 5). The weed-free treatment, Pallas and Limitless treatments caused an increase in plant height by (100.67, 101 and 100.44) cm respectively, early on in the season. In the second season, it increased plant height by 99.7, 98.4 and 99.0 cm, respectively. Compared to the weedy treatment, which gave the lowest average plant height of 93.67 and 90.7 cm for both seasons, respectively (Table 5). This occurs as a result of the efficacy of herbicides in lowering the total quantity of weeds as well as their dry weight (Table 3 and 4) Which provided a suitable environment for the crop to grow without competition for the growth requirements of water, nutrients and light. Therefore, the photosynthesis process's efficiency increased and the vital activities of the crop increased, and that by elongating the internodes, It led to an increase in the plant's height. This outcome was consistent with studies by (4, 20, 23, 24), which demonstrated that the use of pesticides to suppress weeds in wheat causes plants to grow taller.

Number of spikes. m^{-2}

The findings demonstrated that the impact of herbicides caused a considerable difference in the number of spikes (m^2). It was found that when the crop and associated weeds were not competing with one another, the greatest number of spikes were produced (weed free and Limitless and Pallas treatments). The number of spikes increased as a result, reaching (488, 441.67, and 412.0) respectively, In the first season, there was an increase of (465.7, 420.0, and 412.0) spikes m^{-2}, and in the second season, it reached 317.3 and 293.3 spikes m-2 as compared to the weedy

treatment, which offered the lowest average for this feature (Table 5). As a result, the presence of the competition factor has a visible influence on the crop's growth and development, as well as the weed's persistence and lack of control, in later phases, could be an important component in the crop's growth and production, thus it is important to pay attention to it. This result is attributed to the effectiveness of these herbicides in reducing the number of weeds and inhibiting their dry weight (Table 3 and 4). This helps the crop plants to grow without environmental stress, Specifically, the crop's and weeds' competition for growth needs. Thus, the efficiency of the photosynthesis process was increased, which in turn led to an improvement in the crop's performance of its vital activities, as a result, the number of spikes per unit area increases. This finding was supported by (3, 4, 20, 21), who indicated that herbicide application increased the number of spikes recorded in each unit of land.

Number of grains. spike^{-1}

The data show that the weed-free treatment, as well as the Limitless and Pallas treatments, outperformed the others by increasing the average number of grains per spike by 35.18%, 32.7%, and 27.3%, respectively, in the first season. In the second season, it obtained a rise rate of 37.5%, 36.08%, and 26.89%, respectively, in contrast to the weed treatment, which yielded the lowest average for the trait of 44.63 and 42.4 grains. Spike-1, which corresponds to both seasons (Table 5). The effectiveness of the weed management could be the cause, in reducing the weed competition for wheat plants and taking advantage of growth requirements such as water, light and nutrients with high efficiency and improving the metabolic activities of the plant. This is consistent with what was found by (18, 20, 21, 24), they observed that the use of herbicides resulted in a greater quantity of grains being produced in the spike as compared to the weedy treatment.

Weight of 1000 grains (g)

The result in table (5) shows a significant difference in the total weight of 1000 grains produced from the using of herbicides. as the results showed in the first season the superiority of Pallas and Limitless by providing the greatest overall average weight of 1000 grains amounted to 36.37 g, Whereas the weed treatment reduced the weight of 1000 grains to an average of 28.53 g. Thus, the average weight of 1000 grains increased by 27.5% as a result of the impact of these two treatments combined. The weed-free treatment, which produced an average of 34.82 g, was the only one of the two pesticide applications that varied. While the second season's results demonstrated the weed-free treatment's superiority by awarding it the highest average weight of 1000 grains, which came in at 36.75 g, they did not significantly differ from those of the Pallas treatment, which came in at 36.27 g, or the Limitless treatment, which averaged 36.05 g. Although with the weedy treatment, the weight of 1000 grains reduced to 28.53 and 28.88 g for the two seasons, respectively. This result is attributed to the availability of a suitable environment for the crop and to benefit from the growth requirements, which led to its healthy growth, which increased the efficiency of the photosynthesis process, this was reflected on the vital activities and so therefore increased the ability of the source to transport the products of photosynthesis and their transmission to the grains, it was the final washbasin and, as a result, was reflected in the rise in grain weight. The absence of bush competition or low numbers and low dry weight (Table 3 and 4) allowed the crop to benefit from the greatest amount of water and raw materials, directly affecting the weight of the grain as the grains are the final recipients of these components. Since the grains are the final sink for these materials, the crop benefited from the greatest amount of water and raw materials, which directly affected the weight of the grain, in the absence of weed competition or low numbers and low dry weight (Tables 3 and 4). This result agrees with what was mentioned by (3, 20, 21 23), that the absence of competition factor between the crop and the accompanying weeds has a positive effect on the weight gain of 1000 grains.

Table 5. Effect of limitless WG and pallas OD on plant height (cm), spike.m^{-2} , seed. Spike^{-1}, weight 1000 seed (g) in two seasons

Treatment	Application rate	First season			
		Plant height	Spike. m^{-2}	Seed. Spike^{-1}	1000seed weight gm
Limitless	400 g ha^{-1}	100.47	441.67	59.20	36.37
pallas	500 ml ha^{-1}	101	412.0	56.83	36.37
weedy	Leave weeds throughout the growing season	93.67	317.33	44.63	28.53
Weedy free	Hand weed control	100.67	488.82	60.33	34.82
	L.S.D ≤ 0.05	4.615	32.789	3.238	3.804
Treatment	Application rate	Second season			
Limitless	400 g ha^{-1}	99.0	420.0	57.7	36.05
pallas	500 ml ha^{-1}	98.4	400.7	53.8	36.27
weedy	Leave weeds throughout the growing season	90.7	293.3	42.4	28.88
Weedy free	Hand weed control	99.7	465.7	58.3	36.75
	P ≤ 0.05	2.76	21.91	3.29	1.756

Grain's yield (ton. ha^{-1})

The findings showed that there were significant differences in grains production due to the weed control methods' effect. since the results of the first season indicated the weed-free treatment's great superiority, as it produced the highest average grain output of 5.92 ton per hectare, followed by the Limitless treatment, which increased grain yield by 5.507 ton per hectare, and the Pallas herbicide treatment, which increased grain yield by 5.27 ton per hectare. While the second season's results demonstrated the weed-free method's superiority by giving it the highest average grain output (5.82-ton ha^{-1}), as it gave the highest average grain yield amounted to 5.92, followed by the Limitless treatment, which gave an increase of 5.507 followed by the Pallas herbicide treatment, which achieved an increase of 5.27 ton. ha^{-1}. While the results of the second season showed the superiority of the weed-free treatment by giving it the highest average grain yield of 5.82 tons. ha^{-1}, which did not differ significantly with both Pallas and Limitless treatments, compared to the weedy treatment, which gave the lowest average of 3.51 and 3.31 tons. ha^{-1} and for both seasons, respectively. This result is attributed to the healthy growth of wheat plants without environmental stress through competition for growth requirements such as water, nutrients and light, this made the photosynthetic process more efficient. It increased the components of the yield (the number of spikes per unit area, the number of grains. Spike^{-1}, and the weight of 1000 grains), which was reflected in the biological performance of the crop (Table 5), This had been reflected significantly in the yield increase, this result agreed with (3, 5, 20, 21), who claimed that the application of herbicides increases grain yield.

Table 6. Effect of control treatments on yield, biological yield and harvest index

Treatments	Application rate	First season		
		Biological yield ton ha^{-1}	Grain yield ton ha^{-1}	Harvest index
Limitless	400 g ha^{-1}	16.10	5.507	34.26
pallas	500 ml ha^{-1}	15.55	5.270	33.87
weedy	Leave weeds throughout the growing season	13.35	3.510	26.29
Weedy free	Hand weed control	17.63	5.950	33.74
	p ≤ 0.05	1.449	0.370	2.192
Treatments	Application rate	Second season		
Limitless	400 g ha^{-1}	15.74	5.51	35.0
pallas	500 ml ha^{-1}	15.49	5.34	34.5
weedy	Leave weeds throughout the growing season	14.83	3.31	22.3
Weedy free	Hand weed control	16.79	5.82	34.6
	p ≤ 0.05	N. S	0.683	1.80

Biological yield (ton. ha^{-1}): The weed-free treatment was significantly superior with the highest percentage increase in the average biological yield of 32.06% and 13.22%, followed by the Limitless treatment with an increase of 20.6% and 6.14%, followed by the Pallas treatment, which achieved an increase of 16.5% and 4.45% compared to the weedy treatment that It gave the lowest biological yield of 13.35 and 14.83 tons. ha^{-1} for both seasons, separately (Table 6). The biological production may have decreased under the weedy treatment due to the presence of the competition factor for the weeds, which clearly affected the growth and development of the crop and then affected the accumulation of dry matter in the different parts of the plant. This result is consistent with what was found by (3, 4, 22), they found that the use of herbicides resulted in a significantly greater increase in biological yield in comparison to weed control.

Harvest index %: The results revealed that the Limitless treatment considerably outperformed the weedy treatment, giving the highest mean harvest index of 34.26% and 35.0% for both seasons, respectively, while the weedy treatment recorded the lowest rate of harvest index of 26.29% and 22.3%. (Table 6). The effect of herbicides increases the limitation of the weed's competition for the crop for the different growth requirements, as the weed density and its dry weight decreased (Table 3 and 4). In order to obtain an increase in the grain yield higher than the increase in the total dry matter yield compared to with plants in weedy treatment, the proper environmental conditions were provided for the growth and production of plant members. This result was confirmed with what was indicated by (3, 4, 9), that the use of weed control had a significant effect in improving the vegetative characteristics, that was indicated in the increase in yield and its components, which was the cause of the harvest index increase as compared to the weedy treatment.

CONCLUSION

As a result of the data shown above, we are able to draw the conclusion that all of the herbicides that were utilized were successful in lowering the total number of weeds as well as inhibiting the total amount of dry weight that the weeds produced when compared to the treatment that served as a control, Therefore, both the yield and its components will increase.

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