EFFECT OF HERBICIDES ON GROWTH, GRAIN YIELD AND QUALITY OF BARLEY

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ABSTRACT

This experiment was aimed to study the effect of herbicide (lintur @180 g.ha^{-1} + Axial @1.5 L.ha^{-1}, Navigator @ 1.25 L.ha^{-1} and the control treatment) in the companion weeds. Besides, grain yield and its components of three cultivars of barley (IPA 99, Buhooth 256, Aldebaran). The experiment was carried out according to RCBD, within split plot arrangement using three replicates. The cultivars represented the Main-plots, while herbicides and control treatments represented the sub-plots. The second included a laboratory experiment with four replicates of 50 seeds per replicate to study some grain quality characteristics resulting from the first field experiment. The results were showed the superiority of the Buhooth 256 cultivar in number of spikes, weight of 1000 grains, and the grain yield with an average of 495.10 spike.m^{-2}, 22.23 g, and 1.46 ton.ha^{-1}, respectively. Buhooth 256 also recorded the best results in increasing the percentage of weed control, reducing weed dry weight, and increasing the inhibition ratio. The same cultivar exceeded in most characteristics of grain quality. The treatment of herbicides (lintur + Axial) exceeded by achieving the highest average number of spikes of (471.60 spike.m^{-2}), and the highest number of grains per spike with (51.77 grain.spike^{-1}). Coupled with the weight of 1000 grains (21.47 g), and the highest grain yield (1.53 ton.ha^{-1}).

Keyword: varieties, weeds, navigator, grainling vigor, grain quality

تأثير مبيدات الادغال في نمو وحاصل وجودة حبوب الشعير

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المستخلص

نفذت دراسة بتجربتين (حقلية وأخرى مختبرية) تضمنت الأولى، تجربة حقلية في الحقل التجريبي لقسم المحاصيل الحقلية، كلية علوم الهندسة الزراعية، جامعة بغداد، الجادرية خلال الموسم الشتوي2021–2022، لدراسة تأثير بعض مبيدات الأدغال توليفة من مبيديlintur بتركيز180 غم هـ$^{-1}$ + Axial بتركيز1.5 لتر هـ$^{-1}$ ومبيد Navigator بتركيز1.25 لتر هـ$^{-1}$ والمعاملة المدغلة Weedy في الأدغال المرافقة والحاصل ومكوناته لثلاثة أصناف من الشعير (اباء 99 ، بحوث 256، Aldebaran). أجريت التجربة وفق تصميم القطاعات الكاملة المعشاة (RCBD) بترتيب الألواح المنشقة بثلاثة مكررات. مثلت الاصناف المعاملات الرئيسة ومبيدات الادغال والمعاملة المدغلة المعاملات الثانوية , وتضمنت الثانية تجربة مختبرية بأربعة مكررات بواقع 50 بذرة لكل مكرر لدراسة بعض صفات جودة الحبوب الناتجة من التجربة الحقلية الأولى , اظهرت النتائج تفوق الصنف بحوث 256 في اعطاء اعلى متوسط لكل من صفة عدد السنابل ووزن 1000 حبة وصفة حاصل الحبوب اذ سجل متوسطا بلغ 495.10 سنبلة م$^{-2}$و 22.23 غم و1.46 طن هـ $^{-1}$,كما سجل بحوث 256 أفضل النتائج في زيادة نسبة المكافحة وتقليل وزن الادغال الجاف وزيادة نسبة التثبيط, وتفوقت معاملة توليفة مبيدي (lintur + Axial) بتحقيقها اعلى متوسط لعدد السنابل(471.60 سنبلة م$^{-2}$) واعلى عدد حبوب بالسنبلة (51.77 حبة سنبلة$^{-1}$) ووزن 1000 حبة (21.47 غم) واعلى حاصل للحبوب (1.53 طن هـ$^{-1}$).

الكلمات المفتاحية: أصناف الشعير، الادغال، مبيد نافيكتور، قوة البادرة، نوعية الحبوب

Received:25/9/2022, Accepted:12/12/2022

INTRODUCTION

Weeds are one of the main agricultural problems for production of thousands of crops when they distributed at the fields of crops. Especially crops which are sensitive to the presence of weeds, which cause some impacts in their competition that leads to a decreases in their productivity and deterioration in the grains quality (2). Several studies were tended to many treatments to get rid of this problem to improve the performance of crop plants to compete with the weeds and reduce the inappropriate conditions of the field (5, 6, 21, 24) . Therefore, different methods were used to control the weeds to eliminate them or reduce their impact, most notably the chemical compounds that were used at the beginning of the last century (4). The method of controlling weeds with herbicides is one of the agricultural techniques, as the spread of weeds reduces the yield and its components (7, 19). This weed competes with crop plants for growth requirements such as water, nutrients, light, and CO_2, and it also acts as a host for diseases and insects in addition to its negative impact on its poor quality (26). Whenever the weed density increases, this is reflected negatively in the decrease in the yield as a result of the reduction in the efficiency of the crop's performance of bioactivities. The negative effect could be exceed the presence of weeds in the bioprocesses inside the grains after harvesting, so many researchers are interested in using herbicides to control barley weeds. (17) indicated the superiority of the herbicides combination (U-46 Combifiluid @ 1 L.ha^{-1} + (Axial @1.5 L.ha^{-1}) by reducing the number of weeds and giving the lowest weed dry weight of 0.00 g.m^{-2} with an inhibition ratio of 100 %. This study was aimed to investigate the effect of some herbicides (a combination of Lintur 180 gm. h^{-1} + Axial 1.5 L. h^{-1}) and Navigator 1.25 L. h^{-1} and the control treatment on companion weeds, yield and its components of three varieties of barley (IPA 99, Buhooth 256, Aldebaran).

MATERIALS AND METHODS

This study was carried out within two experiments (field and laboratory), the first conducted at the experimental field of the Department of Field Crops, College of Agricultural Engineering Sciences, University of Baghdad, during winter season 2021-2022. The experiment was aimed to study the effect of (a mixture of lintur @180 g.ha^{-1} + Axial @1.5 L.ha^{-1}, Navigator @ 1.25 L.ha^{-1} and the control treatment). Besides, the grain yield and its components of three cultivars of barley (IPA 99, Buhooth 256, Aldebaran) according to RCBD, within the split plot arrangement using three replicates. The cultivars represented the main plots, while herbicides and control treatments represented the subplots each experimental unit included 10 rows, and the distance between rows and was 20 cm, the rows length 2m. The seeds were sown in 12/12/2021 and harvested on 29/4/2022. The knapsack sprayer was used to application the herbicides under a pressure of 4-5 bar, as the two herbicides (lintur + axial) were sprayed sequentially in the same experimental unit and the Navigator herbicide once. Urea 46% N fertilizer was used at a rate of 300 kg.ha^{-1} and added in two batches, the first at planting and the second after 45 days, triple superphosphate fertilizer 45% P_2O_5 as a source of phosphorus at a rate of 100 kg P_2O_5 ha^{-1}. An area of 1 m^2 was taken in the center of the experimental unit. The percentage of weed control (%),weeds dry weight (g.m^{-2}) at harvest, where the weeds were cut at the soil surface level from an area of 1 m^2 taken randomly and placed in perforated bags and then placed in the oven at a temperature of 70 ° C until the weight was constant. Then, the inhibition ratio in the weed dry weight was calculated for different treatments according to the following equation:

$$\text{Inhibition } \% = [100 - \frac{A}{B}\ ] \times 100$$

Where: A = weed dry weight in weed control treatments.

B = weed dry weight in the control treatment (10).

The second experiment:

A laboratory experiment was carried out with four replicates of 50 seeds per replicate to study some grain quality traits resulting from the field experiment. Percentage of the standard laboratory germination (%) (**16**), Germination time, Radical length (cm) and plumule length (cm), Seedling vigor index (20).

Statistical analysis: The data were analyzed using the Genstat statistical program using the

analysis of variance method for the RCBD design within a split-plot, and the arithmetic means were compared using the Least Significant Difference L.S.D method at the probability level of 0.05 according to (11).

RESULTS AND DISCUSSION

Effect of herbicides on grain yield and its components of barley: The results in Table 1 indicate that there are significant differences among the cultivars under study. The Buhooth 256 cultivar exceeded and produced the highest average of the number of spikelet, the weight of 1000 grains, and grain yield, and recorded of 495.10 spikes.m^{-2}, 22.23 g and 1.46 ton.ha^{-1}. The comparison, to the Aldebaran cultivar when recorded the lowest average of the number of spike.m^{-2} and the weight of 1000 grains and the grain yield, which amounted to 412.40 spike.m^{-2}, 18.79 g and 1.2 ton.ha^{-1} for the characteristics, respectively. However, the cultivar itself did not differed significantly grains. Spike^{-1}and the weight of 1000 grains, recording the lowest averages. The reason for the discrepancy in recording the best averages in the characteristics under study could be due to the genetic nature of the cultivar. The same table shows the superiority of the treatment of the herbicides combination (lintur + Axial) for all characteristics, which achieved the highest average number of spikes (471.60 spike.m^{-2}), the number of grains .spike^{-1} (51.77 grain.spike^{-1}). In addition to the weight of 1000 grains (21.47 g), and the highest grain yield (1.53 ton.ha^{-1}), which did not differed significantly from the herbicide Navigator in recording the best averages compared to the control treatment, which recorded the lowest averages, this is consistent with what was found (1 , 8, 15) in the existence of significant differences between cultivars in yield and its components of barley crop. The reason due to herbicide treatments the best results and their great superiority over control treatment could be due to the effectiveness of mixing herbicides and herbicides in general and their effective effect in controlling weeds (8, 9, 12, 13, 22). Besides, reducing their number and dry weight and increasing their control percentage as shows in Table 2. The use of herbicides led to a decrease in the number of companion weeds to the barley crop Table 2, which led to a decrease in competition between plants per unit area for light and nutrients.

Table 1. Effect of herbicides and cultivars on yield and its components of some barley cultivars

Characteristics / Treatments		Number of spikes.m^{-2}.	Number of grains.spike^{-1}	Weight of 1000 grains (g)	Grain yield Ton.ha^{-1}
IPA 99		417.80	50.68	21.15	1.36
Buhooth 244		495.10	52.99	22.23	1.46
Aldebaran		412.40	45.52	18.79	1.20
L.S.D 0.05		14.77	N.S	3.35	0.08
lintur + Axial		471.60	51.77	21.47	1.53
Navigator		453.30	51.07	21.25	1.48
Weedy		400.40	46.36	19.45	1.02
L.S.D 0.05		17.80	2.52	1.44	0.08
IPA 99	lintur + Axial	465.30	52.43	22.20	1.44
	Navigator	430.70	51.40	22.45	1.65
	Weedy	357.30	48.20	18.79	1.01
Buhooth 256	lintur + Axial	518.70	54.83	23.43	1.81
	Navigator	504.70	53.80	22.00	1.49
	Weedy	462.00	50.33	21.27	1.09
Aldebaran	lintur + Axial	430.70	48.03	18.78	1.34
	Navigator	424.70	48.00	19.31	1.31
	Weedy	382.00	40.53	18.29	0.97
L.S.D 0.05		N.S	N.S	N.S	0.12

Therefore, it was positively reflected in increases in the efficiency of carbon fixation, increases in the rate of dry matter accumulation within plant traits. Moreover, the conversion efficiency of that dry matter to an economic outcome, represented by an increases in the number of spikes per unit area, number of grains.spike^{-1}, and the weight of 1000 grains which highest average grain yield. The results also indicated that there is no

significant bilateral interaction between the cultivars and the control treatments in the characteristics of the number of spikes, the number of grains.spike^{-1}, and the weight of 1000 grains. Though, there were significant differences in the interaction in the grain yield characteristic only, as the Buhooth 256 cultivar with herbicides (lintur + Axial) achieved the highest mean reaching 1.81 ton.ha^{-1}. In comparison, the lowest average recorded by Aldebaran cultivar with the control treatment, as the average grain yield was 0.97 ton. ha^{-1}.

Effect of herbicides and cultivars on companion weeds: The results of Table 2 show that there are no significant differences for the cultivars in the characteristic of the number of weeds m^{-2}. However, there were significant differences in the characteristic of the control percentage, weed dry weight, and the inhibition percentage, as the Buhooth 256 cultivar exceeded had the best results. It was recorded the highest control percentage, the lowest weed dry weight, and the highest inhibition percentage of 47.51%, 143.30 gm, and 49.91%, respectively. The herbicides combination treatment (lintur + Axial) exceeded by achieving the lowest average number of weeds of 10.44 plant.m^{-2}, the highest control percentage of 89.09%. Then, the lowest weed dry weight of 34.50 g and the highest inhibition percentage of 88.39%, compared to the control treatment, which recorded the lowest averages for all characteristics.

Table 2. Effect of herbicides and cultivars on the characteristics of the companion weed

Treatments \ Characteristics		Number of weeds.m^{-2}	Control %	Weeds dry weight g.m^{-2}	Inhibition %
IPA 99		55.44	45.87	163.20	45.82
Buhooth 244		49.56	47.51	143.30	49.91
Aldebaran		43.00	41.73	162.90	44.75
L.S.D 0.05		N.S	0.96	3.40	1.11
lintur + Axial		10.44	89.09	34.50	88.39
Navigator		51.56	46.01	140.90	52.10
Weedy		96.00	0.00	294.10	0.00
L.S.D 0.05		2.90	1.85	5.52	1.58
IPA 99	lintur + Axial	13.33	87.06	47.60	84.20
	Navigator	50.67	50.54	140.70	53.27
	Weedy	102.33	0.00	301.20	0.00
Buhooth 256	lintur + Axial	3.67	96.00	11.50	96.05
	Navigator	50.33	46.51	132.40	53.70
	Weedy	94.67	0.00	286.10	0.00
Aldebaran	lintur + Axial	14.33	84.21	44.40	84.93
	Navigator	53.67	40.97	149.40	49.32
	Weedy	91.00	0.00	294.90	0.00
L.S.D 0.05		7.96	2.69	8.10	2.35

The results show that there is a significant interaction between cultivars and herbicides, as it is noted that the cultivar Buhooth 256 exceeded the herbicides (lintur + Axial) by giving the best averages for the characteristic of the number of weeds m^{-2}. and, the control percentage, the characteristic of the weeds dry weight, and the inhibition percentage, as it amounted to 3.67 plant.m^{-2}, 96.00%, 11.50 g.m^{-2} and 96.05%, respectively. It is also observed from the Table that the herbicides combination of (lintur + Axial) has reduced the number of weeds and their dry weights. This interaction led to an increases in the control and inhibition percentage in the dry weight compared to the Navigator and the control treatment, which indicates that the mixing of herbicides increased their efficiency in controlling the weeds. These results confirm the synergistic effect of mixing herbicides, which leads to targeting more than one effective site in the weeds, and thus it is possible to break the resistance of some weeds. These results are consistent with the findings of (14, 18, 23, 25) that herbicides, whether mixed or not, led to an increase in yield and its components and a decrease in the numbers and weights of companion weeds to the crop.

Effect of herbicides and cultivars on some grain quality characteristics: The data in Table 3 indicates that there are significant differences between barley cultivars in most of the grain quality characteristics resulting from the field experiment. The data indicates the

superiority of the IPA cultivar in the percentage of standard laboratory germination, reaching 95.42%. Then, the Buhooth 256 cultivar exceeded in the characteristics of radical length (3.65 cm), plumule length (9.05 cm), and grainling vigor index (1181). The Aldebaran cultivar gave the lowest averages for the aforementioned characteristics, barley cultivars did not recorded significant differences in the characteristic of germination time. The significant differences between the different barley cultivars in most of the grain quality characteristics could be due to the different genetic nature of these cultivars. The data also indicates that the herbicides combination (lintur + Axial) was significantly superior by giving the highest averages for the quality of barley grains. This interaction had the highest average for the characteristic of the standard laboratory germination percentage (95.67%), the highest average for the germination time (4.67%), and the highest average radical length (3.55 cm). Besides, the highest average plumule length is (8.74 cm) and the highest average for the grainling vigor index (1176), without recording significant differences with the Navigator herbicide. While control treatment had the lowest average for the standard laboratory germination percentage and germination time, which amounted to 88.25% and 3.33%, respectively. Moreover, the lowest average radical length and the plumule length, reached 2.77 cm and 7.81 cm, respectively, and the lowest average for the grainling vigor index reached 935. The reason the superiority of herbicide treatments in giving the highest averages of grain quality characteristics indicates its superiority by giving the highest averages of grain weight as shows in Table 1. As the increases in the efficiency of carbon fixation and the rate of accumulation and conversion of dry matter led to the production of grains capable of giving the highest percentage of strong normal grainlings capable of giving plants with high vitality, which may be reflected in the increases in yield in the next generations. The data in Table 3 indicates that there is a significant interaction between barley cultivars and control treatments in the characteristics of the percentage of standard laboratory germination, radical length, and grainling vigor index. The reason for this could be that the cultivars varied in their response to different control treatments, while the response was similar between barley cultivars in terms of germination time and plumule length.

Table 3. Effect of herbicides and cultivars on some barley grain quality characteristics

Characteristics / Treatments		Standard laboratory germination (%)	Germination Speed (%)	Radical length (cm)	Plumule length (cm)	Grainling vigor index
IPA 99		95.42	3.58	3.13	8.05	1069
Buhooth 244		92.83	4.50	3.65	9.05	1181
Aldebaran		90.33	4.17	3.03	7.96	996
L.S.D 0.05		0.966	N.S	0.132	0.179	20.78
lintur + Axial		95.67	4.67	3.55	8.74	1176
Navigator		94.67	4.25	3.49	8.51	1136
Weedy		88.25	3.33	2.77	7.81	935
L.S.D 0.05		1.227	0.601	0.146	0.095	24.75
IPA 99	lintur + Axial	97.50	4.25	3.45	8.38	1153
	Navigator	97.50	3.50	3.13	8.23	1106
	Weedy	91.25	3.00	2.83	7.55	947
Buhooth 256	lintur + Axial	94.75	5.00	3.88	9.43	1260
	Navigator	94.25	4.75	4.15	9.25	1263
	Weedy	89.50	3.75	2.93	8.48	1020
Aldebaran	lintur + Axial	94.75	4.75	3.33	8.43	1113
	Navigator	92.25	7.50	3.20	8.05	1038
	Weedy	84.00	3.25	2.58	7.40	838
L.S.D 0.05		1.891	N.S	0.231	N.S	38.61

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