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CONTROL OF NARROW AND BROAD WEEDS IN MAIZE (*ZEA MAYS L.*) BY USING ADENGO HERBICIDE

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Abstract

This study was conducted to eliminate the weeds accompanying the maize crop in Al- Rashidiya region in one of the northern suburbs of Mosul, Nineveh province, during the 2021 season in the northern region of Iraq, to evaluate the efficiency of a selectivity herbicide newly introduced into Iraq. The study included two factors: the first factor was the use of the herbicide (Adengo) in three concentrations (200, 300, 400 ml.ha^{-1}) and a free weeds treatment (hoeing throughout the growing season) and the control treatment. As for the second factor, two cultivars of maize were used, the first (local, government cultivar) and the second, an imported hybrid (Dk 5060), as seasons were included as a third factor in the aggregate analysis. Statistical analysis was conducted by Randomized Complete Block Designs according to the factorial experiment system, and Duncan's multiple-range test was used using the computer according to the (SAS) program .The results were summed up with the adengo herbicide at a concentration of (400 ml. H) which showed significantly excelled in eliminating narrow and broad-leaved weeds and reducing them when flowering. The efficiency of the adengo herbicide was equal at a concentration of (300, 400 ml. ha^{-1}) as it did not differ significantly despite the excelled of the concentration (400 ml.ha^{-1}) in the autumn season. In addition to the excelled of the herbicide at a concentration of (400 ml.ha^{-1}) in most growth and yield traits. The use of the herbicide at a concentration higher than the recommended led to an increase in weed killing, where its efficiency in reducing the dry mass of the weeds was (71%) and its efficiency in reducing the density of the weeds was (75%) compared to the weed control treatment. at a concentration of (400, 300) ml.ha^{-1} in the case of leaves area, The autumn season showed a significantly excelled on the spring season in terms of grain yield and protein yield.It was also noted that the quantity of yield increased when using adengo herbicide at a concentration of (400 ml.ha^{-1}) in the autumn season by (40%) for the imported cultivar compared to the control treatment and for the local cultivar by (16%). As for the autumn season of the imported variety, the increase was by (26%) and for the local one by (19%) also compared to the control treatment, and the increase in the grain yield of the imported variety in the autumn season compared to the control treatment in the autumn season of the local cultivar amounted to (54%).

Keywords: maize, *Zea mays* L., Adengo herbicide

Introduction

The maize crop is one of the grain crops belonging to the Poaceae family, where it comes in third place after wheat and rice in terms of global production and cultivated area, and maize is of great importance in terms of its strategic uses. As it enters into human nutrition and in many industries, including the paper industry, where maize leaves are included as a basic material in it. As for the

grains of the crop, the best types of oils and starch are extracted from them, and they are of great importance in animal nutrition.As it is considered one of the fast-growing feed crops and abundant production of green feed, and its grains are also included in the basic ingredients in the manufacture of feeds for poultry and ruminants, and it is considered a good feed with all its vegetative and fruit parts .Despite the importance of maize, its production is still low due to the failure to follow scientific methods and modern agricultural methods or practices in the growth and improvement of the crop to reduce the negative and harmful effects of weeds accompanying the maize. The weeds are considered an insignificant competitor to field crops in general and to Poaceae crops in particular, where the crop plant competes for life factors such as water, location, nutrients and light in some cases, as well as the weeds are a host for many diseases and insects that affect crops, including maize. Where they are sensitive to weeds competition in the initial stages of growth and are exposed to insect infections such as the maize stalk borer that kills the crop. Which causes a loss in the grain yield and increases with the increase in the types and density of weeds. Therefore, the weeds must be removed early in the growth of the crop in order to reduce the loss in the grain yield.One of the most common methods of weed control is the use of selective herbicides.

Materials and methods

The study included weeds control experiment, which included the use of Adengo herbicides after germination in weed control thin and broad-leaved weeds in maize fields and its effect on yield and its components. The experiment was conducted during the season for the year 2021 in the Al-Rashidiya region in one of the northern suburbs of the city of Mosul in the Nineveh province, for the spring and autumn seasons. The land was prepared for cultivation using Moldboard plows with two perpendicular tillage, then the smoothing and leveling process was conducted by means of the knife and then the milling using furrows, and the width of the mead was 75 cm. The field was divided into three replicates, each replicate representing a duplicate containing (10 treatments) on (2/3/2021) for the spring season and (20/6/2021) for the autumn season. The seeds were sown on (27/3/2021) in the spring season, and on (1/7/2021) in the autumn season, at a depth ranging between (5-7 cm) approximately on the irrigation line and at an average (2-3) seeds in each pit or pit. and each experimental unit included (4 fur rows) with a length of (4 m) and the distance between plants (15 cm), and the average number of plants in the field became 88 thousand.ha^{-1} plants also added compound fertilizer at an average of 400 kg. ha^{-1} After performing the slipping operation in the form of stripes,120 kg ha^{-1} was added. of nitrogen fertilizer when flowering and according to the recommendations of the Ministry of Agriculture. The thinning plants were made to one plant per pit after the plant reached a height of (20-25 cm) on (17/4/2021) for the spring opening and on (19/7/2021) for the autumn season. A preventive control of agricultural insect pests was conducted periodically every 15 days throughout the period of the crop's presence in the experimental land.

The study included two factors, and the season was included as a third factor in the experiment
The first factor: cultivars a1: local cultivar (government), a2: imported cultivar (DK5060)
The second factor: the control parameters where they were

b1 : 200 ml.ha^{-1} , Adengo B 2 : 300 ml.ha^{-1} Adengo herbicide
b3 : 400 ml.ha^{-1} Adengo herbicide , B4: free weeds , B5: weed (control treatment), third factor S: first season (spring), second season (autumn)
Studied traits: total number of weeds. m ^{2} when in flower, the dry weight of the total weed is g. m ¬2 at flowering, leaf area index (cm), ear length (cm), number of rows per ear, number of grains per ear, average weight of grains per cob(grain yield kg.h) (gm), protein percentage %.The data were analyzed using the SAS program and Duncan's multiple range test to test for means. And the control treatment (without control) at an average of (62%, 52%, 77%), respectively, due to the positive lethal effect of the herbicide at a concentration of (400 ml.ha^{-1}), which led to a reduction in the number of narrow leaves weeds in the experimental unit.

Results and discussion

1 - The density of the high-narrow leaves weeds: the presence of the planted weeds with the crop causes great competition for field crops, especially the Poaceae , including maize As it works, the results obtained from Table (No. 1) show that there is a significant difference between the control treatments, where the adengo herbicide treatment with a concentration of (400 ml.ha^{-1}) excelled on all treatments with a concentration of (200 ,300 ml.ha^{-1})This was confirmed by many researchers in the field of weed control the narrow weeds in maize fields by using a high concentration of selectivity herbicide (Manea et al. 2010, Trnjain and Dikic 2012). As for the cultivars, there were no significant differences in their effect on the number of narrow leaves weeds in the field, where the competition between plants of the same type is more intense than competition with plants of the other species. From the same table, it appears that there is a significantly excelled in the number of narrow leaves weeds in the autumn season on the spring season, where it gave the lowest number of narrow leaves weeds amounted to (23.33 weeds. m^{2})This number is 26% less than the spring season, where the number of weeds decreased in the autumn season compared to the spring season by 26%.The reason for this is due to the different environmental conditions between the two seasons, where weed plants are more active in the spring season than in the autumn season, and this is consistent with what some researchers have said.(AL-Obaidi, 2019).

2- The dry mass of narrow leaves weeds : the results obtained from table (2) show that there is a significant difference between the control treatments and control treatment. The treatment of Adengo herbicide with a concentration of (400 ml.ha^{-1}) excelled on the treatments of (200, 300 ml.ha^{-1}) and the control treatment by (51%, 29%, 72%), respectively, where it gave the lowest dry mass of weeds which was (28.6 g. m^{2}) and this decrease in the dry mass compared to other treatments where a result of the killing of weeds by the herbicide and its effective effect on them, and this result is consistent with the findings of some researchers (Latheeth et al, 2009) and through Table. The dry mass was (41.1 g. m^{2}). The dry mass also decreased by (20%) compared to the local cultivar, and the reason is due to the size of the biological mass of the imported cultivar, which in turn led to shading the weeds plants and reducing their efficiency in the photosynthesis process compared to the local variety. The results in Table 2 indicate that there is a significant difference between both seasons, where the autumn season excelled on the spring season by giving

it the lowest dry mass of narrow leaves weeds, which amounted to (25.79 g. m^2).Where the dry mass of weeds decreased in the autumn season by (61%) compared to the spring season, and the reason for this is due to the activity of vegetative growth in the spring season, which led to an increase in the dry mass, due to the environmental conditions suitable for vegetative growth in the spring season (AL-Attar 2022).As for the interaction between seasons and cultivars, the imported and local cultivar in the autumn season excelled the imported and local cultivar in the spring season by giving it the least dry mass of the narrow weeds, while the cultivars did not differ significantly among themselves in the autumn season.As for the spring season, the imported cultivar excelled on the local one in the spring season. The results in Table (2) show that there is a significant difference between the control treatments in reducing the dry mass of narrow weeds Whereas, the treatment of Adengo herbicides narrow leaves weeds at a concentration of (400 ml. e) in both local and imported cultivars excelled on the control treatment and did not differ significantly with the control treatment at a concentration of (300 ml.ha^{-1}) in both cultivars. Where the efficiency of the treatment of Adengo herbicides at a concentration of (400 ml. H) in reducing the dry mass of weeds of the local and imported cultivars was (77%, 66%), respectively.

3- Broad weeds density: The results obtained from Table 3 indicate that there are significant differences between the control treatments in the number of broad leaf weeds. The treatment of adengo herbicide at a concentration of (400 ml.ha^{-1}) excelled on all weed control and control treatments, where it gave the lowest number of weeds amounting to (7.50 weeds. m^2).The weeds density was reduced by (54%, 41%, 70%) for the treatment (200, 300 ml. e) and the control treatment, respectively, where the effect of the herbicide is clearly visible in reducing the number of broad weeds in the experiment unit.This was confirmed by researchers in the field of weed control by using Selectivity herbicide to eliminate of the broad weeds(AL-Attar 2022). The results in the same table indicate that there are no significant differences between maize cultivars in reducing the number of weeds. As for the seasons, the autumn season excelled on the spring season by giving the least number of broad weeds in the autumn season compared to the spring season, where the average number of weeds in the autumn season was (10.70 g m ^{2} (a decrease of (24%) compared to the spring season. This is due to the appropriate environmental conditions for the vegetative growth of the spring season and the increased chance of weed seed germination in the spring.

4- Dry mass of broad-leaved weeds: The results obtained from table (4) indicate a significant difference between the control treatments in their effect on the dry mass of broad-leaved weeds in maize crop, as the control treatment was excelled on Adengo at a concentration of (400 ml. ha^{-1}). Significantly on a herbicide treatment with concentration (200, 300, control treatment)It gave the lowest dry mass in the broad-leaved weeds, which amounted to (24.8 g. m^2), and the treatment efficiency was in reducing the dry mass of weeds by (70%). This indicates the effectiveness of the herbicide in eliminating weeds per unit area, and this agrees with many researchers in the field of weed control using Selectivity herbicide at a concentration higher than the recommended (AL-Barzenchi 2017, AL-Qaisi and AL-Hiti 2017, AL-Attar 2022). From the same table, the results show that there is no significant difference between the cultivars in their effect on the dry mass of

broad-leaved weeds. As for the effect of seasons in reducing the dry mass of weeds , table (4) shows the autumn season excelled on the spring season by giving the least dry mass of broad-leaved weeds(25.03 $g.m^2$), with a difference of (49%) from the spring season, which helped the plant increase vegetative growth and consequently the increase of dry mass in broad-leaved weeds as a result of suitable conditions for growth, and this result is consistent with what was found by (AL-Obaidi, (2019).The results in Table (4) indicate that there is a significant difference in the effect of seasons and cultivar on the dry mass.The local and imported cultivars in the autumn season excelled on the two cultivars in the spring season by giving them the lowest dry mass of (21.0, 29.1 $g.m^2$) for the imported and local cultivars, respectively, due to the activity of vegetative growth in the spring season.

5- Plant height (cm): The results obtained from Table (5) indicate that all weed control treatments excelled on the control treatment, where the Adengo herbicide treatment with a concentration of (400 $ml.ha^{-1}$) excelled on control treatment, where the highest plant height was recorded (200.3 cm).) The efficiency of the treatment was in increasing the plant height by (2%) compared to the control treatment and it did not differ significantly with the control treatments compared with the control treatment and it did not differ significantly with the control treatments at a concentration of (300,200 $ml.ha^{-1}$). The reason for this is due to the natural growth of the yellow maize plant and the lack of weeds due to the deadly effect of the herbicide and giving the plant enough opportunity to form a good vegetative group.(Khazali 2016, AL-Obaidi, 2019).As for the effect of the cultivars' average on the plant height traits, the results in the same table indicate that there is no significant difference, and there was no effect on the plant height average of the cultivars because the plant height traits are related to the environmental conditions and genetic factors of the cultivars. The results in Table 5 indicate that there is a significant difference in the effect of seasons on plant height, where the autumn season was superior to the spring season, where the highest average of plant height was 195.1 cm, with an efficiency of (7%) compared with the spring season. This is due to the smaller number of weeds in the autumn season compared to the spring season, which in turn led to an increase in competition among the plants of the same crop (AL-Obaidi, 2009, AL-Obaidi, 2019).

6- Leaf area: The results obtained from Table (6) indicate that there is a significant difference between the control treatments among them compared with the control treatment in its effect on the leaf area of the plant. A herbicide treatment with a concentration of (400 $ml.ha^{-1}$) was excelled on all weed control and control treatments, where it gave the highest leaf area (7457 cm) and the treatment efficiency was in increasing the leaf area of the plant compared with the control treatment (without control)by (26%).The reason for this is due to the efficiency of the plant in forming a good vegetative group and the small number of weeds in this treatment Table (6), and this is due to the effect of the efficiency of the herbicide, which reduced the number of weeds and was reflected in the increase in the leaf area in the plant (Latheeth et al,, 2009, Saeed et al, 2012). , AL-Obaidi 2019,).The results in Table (6) indicate that there is no significant effect of the cultivar on the average leaf area of the plant as it is affected by environmental conditions and genetic factors (AL-Sahoki 1990, Aziz 2011). As for the effect of seasons, there was no significant effect

on the average leaf area of the plant for the same reason mentioned above .As for the interaction between seasons and cultivars, the results in Table (6) indicate that there is no significant difference between the average leaf area of the plant, and the effect of cultivars with seasons on this trait did not appear. As for the interaction between seasons and cultivars, the results in Table (6) indicate that there is no significant difference between the average leaf area of plants, and the effect of cultivars with seasons on this trait did not appear.

7- Grain yield(kg.ha^{-1}): The grain yield per unit area is an important trait. It is the final outcome of the biological and physiological processes conducted by the plant from germination to maturity since the grain is the final sink of the plant's products.The results obtained from table (7) indicate that there are significant differences between the control treatments in their effect on grain yield per unit area, where the treatment of adengo with a concentration of (400 ml.ha^{-1}) was excelled on that of a herbicide with a concentration of (200 ml.ha^{-1}), and the control treatment.)It did not differ significantly from the herbicide treatment with a concentration of (300 ml.ha^{-1}) and the free weeds treatment, where it gave the highest yield (12.626 ml.ha^{-1}) and the efficiency of the treatment was in increasing the yield compared to the control treatment by (27%), and this result is consistent with what was stated by some Researchers in the field of weed control using optional pesticides (AL-Attar 2022, AL-Qaisi 2017). The reason for the increase in the yield is due to the efficiency of the pesticide in eliminating the weed and reducing its density in the experimental unit giving it the lowest number of weed plants amounted to (7.5 weeds) (Table 1) and the least dry mass of the weed reached (24.8 g.m^2) Which helped the plant reduce competition with weed plants and this led to good plant growth (vegetative growth) and giving the highest leaf area this prompted the plant to start the stage of fruit growth early and early flowering and thus led to an increase in the length of the cob and the number of grains in a row and an increase in the quality of seeds (weight 500 grain) and thus the amount of yield increased compared to the other treatments, and the herbicide treatment with a concentration of (400 ml.ha^{-1}) was more efficient than the free weeds treatment with an efficiency of (6%).The reason for the low yield of the weeds-free treatment that was conducted on hoeing operations (uprooting by hand from the surface of the soil) throughout the season from germination to harvest is that the hoeing process leads to damage to the roots of the crop plants and some mechanical damage to the plants during the procedure Al-Azeeq (AL-Obaidi ,2009, Khalil et al, 2015). The results in (Table 7) indicate that there is a significant difference for the cultivars in their effect on the amount of yield per unit area, as the imported cultivar excelled on the local cultivar by giving it the highest yield amounting to (12234 kg.ha^{-1}) with a difference of (2261 kg.ha^{-1}) from the local cultivar.The reason for this is due to the efficiency of the imported hybrid cultivar in its high competitiveness and the genetic factors specific to the cultivar, which led to an increase in the efficiency of biological processes and thus an increase in the yield (AL-Qaisi 2017). The results in the same table indicate a significant difference in the effect of seasons on the grain yield per unit area, where the autumn season excelled on the spring season by giving it the highest yield rate of (12117 kg.ha^{-1}) with a difference of (2033 kg.ha^{-1}). The reason for this is due to the influence of environmental factors suitable for fruit growth and the increase in the efficiency of the photosynthesis process in plants, which led to

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an increase in the deposition of dry matter in grains more than in the spring season, and this result is consistent with what was stated (khether 2019 AL-Obaidi 2020 ,).

8- Plant protein yield (gm): The results obtained from the table (8) indicate a significant difference between the control treatments in their effect on the protein yield in the plant. The treatment of adengo herbicide with a concentration of (400 ml.ha^{-1}) was excelled on the control treatment and herbicide treatment with a concentration of (200 ml.ha^{-1}) and it did not differ significantly with the free weeds treatment and the herbicide treatment with a concentration of (300 ml.ha^{-1}) by giving it the highest protein yield of (15.56 g).The reason for this is due to the increase in the average weight of the grains per plant (Table 20) with the efficiency of the treatment in reducing the weed by weight and quantity.As for the rate of cultivars in their effect on protein yield, there were no significant differences between cultivar average in the trait of protein yield where it is a qualitative trait that is not affected by genetic factors, but is affected by environmental factors, including drought (Ibrahim, 2013).The results obtained from the same table indicate that the autumn season significantly excelled on the spring season by giving it the highest protein yield in the plant, which reached (14.77 g) The reason for this is due to the high temperatures in the autumn season compared to the spring season, which led to an increase in the chance of drought, which helps to increase proline acid and thus increase the proportion of protein (Ibrahim, 2013).

Table (1): The effect of cultivars and weed control treatments on the density of narrow-leaved weeds per m^2 for the spring and autumn seasons in Nineveh province for the 2021 season.

cultivars average	cultivars × weed control treatments					treatments
	weed control treatments					
	control	free weeds	herbicide concentration 400	herbicide concentration 300	herbicide concentration 200	
29.16 a	59.50 a	0.0e-	14.16d	32.33b C	39.83b	local cultivar
25.60 a	59.16 a	0.0e	12.83d	24.00b C	32.00b C	imported cultivar
	59.33 a	0.0d	13.50C	28.16b	35.91b	Weed control treatments average
Seasons average	Seasons × weed control treatments					
31.43 a	66.66 a	0.0f	14.50e	33.50C d	42.50b C	spring season
23.33 b	52.00 b	0.0f	12.50e	22.83d e	29.33d	Autumn season
Seasons ×	Seasons × cultivars × weed control treatments					

cultivars							
35.20a	70.7 a	0.0h	15.3 g h	40.7 C – e	49.3 b – d	local cultivar	spring season
27.667 b	62.7 a b	0.0h	13.7 g h	26.3 e – g	35.7 d – f	imported cultivar	
23.133 b	48.3 b –d	0.0h	13.0g h	e - g24.0	30.3e – g	local cultivar	Autumn season
23.533 b	55.7 a –C	0.0h	12.0g h	21.7 f g	28.3e - g	imported cultivar	

Averages with the same letter do not differ from each other morally, and their letters differ significantly from each other

Table (2): The effect of cultivars and weed control treatments on the traits of the dry mass of narrow weeds per m^2 for the spring and autumn seasons in Nineveh province for season 2021

cultivars average	cultivars × weed control treatments					treatments
	weed control treatments					
	control	free weeds	herbicide concentration 400	herbicide concentration 300	herbicide concentration 200	
51.1 a	120.0 a	0.0 f	28.2 e	41.2 d e	66.4 C	local cultivar
41.1 b	86.5 b	0.0 f	29.0 e	39.3 d e	50.7 C d	imported cultivar
	103.2 a	0.0 e	28.6 d	40.2 C	58.6 b	Weed control treatments average
Seasons average	Seasons × weed control treatments					
66.46 a	140.5 a	0.0 f	41.0d	57.3C d	93.5b	spring season
25.79 b	C66.0	0.0 f	e f16.2	e23.2	e23.6	Autumn season
Seasons × cultivars	Seasons × cultivars × weed control treatments					
75.9 a	176.7 a	0.0 f	40.7 d e	56.7 C d	105.7 b	local cultivar	spring season
57.0 b	104.3 b	0.0 f	41.3 d e	58.0 C d	81.3 b	imported cultivar	

26.4 C	63.3 C d	0.0 f	15.7 e f	25.7 e f	27.2 e f	local cultivar	Autumn season
25.2 C	68.7 C	0.0 f	16.7 e f	20.7 e f	20.1 e f	imported cultivar	

Averages with the same letter do not differ from each other morally, and their letters differ significantly from each other

Table (3): The effect of cultivars and weed control treatments on the density of broad weeds of m^2 for the spring and autumn seasons in Nineveh province for season 2021

cultivars average	cultivars × weed control treatments					treatments
	weed control treatments					
	control	free weeds	herbicide concentration 400	herbicide concentration 300	herbicide concentration 200	
12.53 a	25.17 a	0.0e	8.50 C d	12.50 b C	16.50 b	local cultivar
12.17 a	25.00 a	0.0e	6.50 d	13.00 b C	16.33 b	imported cultivar
	25.08 a	0.0e	7.50 d	12.75 C	16.42 b	Weed control treatments average
Seasons average	Seasons × weed control treatments					
14.00 a	25.50 a	0.0d	9.50 C	16.33 b	18.67 b	spring season
10.70 b	24.67 a	0.0d	5.50 C	9.17 C	14.17 b	Autumn season
Seasons × cultivars	Seasons × cultivars × weed control treatments					
14.07 a	25.33 a	0.0g	11.00 C - f	16.67 b - d	17.33 b C	local cultivar	spring season
13.93 a	25.67 a	0.0g	8.00 e f	16.00 b - d	20.00 a b	imported cultivar	
11.00 b	25.00 a	0.0g	6.00 e - g	8.33 e f	15.67 b - d	local cultivar	Autumn season
10.40b	24.33 a	0.0g	5.00 f g	10.00 d - f	12.67 C - e	imported cultivar	

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Table (4): The effect of cultivars and weed control treatments on the dry mass traits of broad weeds per m2 for the spring and autumn seasons in Nineveh province for the 2021 season.

cultivars average	cultivars × weed control treatments					treatments	
	weed control treatments						
	control	free weeds	herbicide concentration 400	herbicide concentration 300	herbicide concentration 200		
35.7 a	86.1 a	0.0e	25.4 C d	27.5 C d	39.5 b C	local cultivar	
38.6 a	80.0 a	0.0e	24.2 d	38.8b C	49.8b	imported cultivar	
	83.0 a	0.0d	24.8 C	33.6b	44.6b	Weed control treatments average	
Seasons average	Seasons × weed control treatments						
49.23 a	100.2 a	0.0e	37.2 C	45.7b C	63.1b	spring season	
25.03 b	65.9 b	0.0e	12.4 d e	20.7 d	26.2 C d	Autumn season	
Seasons × cultivars	Seasons × cultivars × weed control treatments						
50.4 a	122.7 a	0.0h	35.3 d - f	39.7 d e	54.3 C d	local cultivar	spring season
48.1 a	77.7 b	0.0h	39.0 d e	51.7 C d	72.0 b C	imported cultivar	
21.0 b	49.5 d	0.0h	15.5 f - h	15.3 f - h	24.7 e - g	local cultivar	Autumn season
29.1 b	82.3 b	0.0h	9.3 g h	26.0 e - g	27.7 e - g	imported cultivar	

Averages with the same letter do not differ from each other morally, and their letters differ significantly from each other

Table (5): The effect of cultivars and weed control treatments on plant height (cm) for the spring and autumn seasons in Nineveh province for the 2021 season

cultivars average	cultivars × weed control treatments					treatments
	weed control treatments					
	control	free weeds	herbicide concentration 400	herbicide concentration 300	herbicide concentration 200	

187.2 a	160.7 b	198.2 a	199.3 a	198.7 a	179.3 a b	local cultivar	
189.2 a	161.2 b	194.0 a	201.3 a	195.8 a	193.8 a	imported cultivar	
	160.9 b	196.1 a	200.3 a	197.2 a	186.6 a	Weed control treatments average	
Seasons average	Seasons × weed control treatments						
181.3 b	151.2 d	193.7 a b	196.0 a b	186.7 a - C	179.2 b C	spring season	
195.1 a	170.7 C d	198.5 a b	204.7 a	207.8 a	194.0 a b	Autumn season	
Seasons × cultivars	Seasons × cultivars × weed control treatments						
175.3 b	140.0 d	190.3 a-C	192.3 a -C	180.3 b C	173.7 b C	local cultivar	spring season
187.3 a b	162.3 C d	197.0 a b	199.7 a b	193.0 a - C	184.7 a -C	imported cultivar	
199.1 a	181.3 b C	206.0 a b	206.3 a b	217.0 a	185.0 a - C	local cultivar	Autumn season
191.1 a	160.0 C d	191.0 a -C	203.0 a b	198.7 a b	203.0 a b	imported cultivar	

Averages with the same letter do not differ from each other morally, and their letters differ significantly from each other

Table (6): The effect of cultivars and weed control treatments on the leaf area traits of plants (cm) for the spring and autumn seasons in Nineveh province for the 2021 season.

cultivars average	cultivars × weed control treatments					treatments
	weed control treatments					
	control	free weeds	herbicide concentration 400	herbicide concentration 300	herbicide concentration 200	
6652 a	5204 d	7181 a	7491 a	7151 a	6236 b C	local cultivar
6546 a	5821 C d	6781 a b	7423 a	6379 b C	6326 b C	imported cultivar

	5513 d	6981 a b	7457 a	6765 b C	6281 C		Weed control treatments average
Seasons average	Seasons × weed control treatments						
6626 a	5365 e	7204 a b	7662 a	6570 b C	6331 C d		spring season
6572 a	5660 d e	6757 b C	7252 a b	6961 a - C	6231 C d		Autumn season
Seasons × cultivars	Seasons × cultivars × weed control treatments						
6685 a	4857 f	7194 a b	7648 a	7275 a b	6453 b - e	local cultivar	spring season
6568 a	5874 d - f	7215 a b	7675 a	5865 d -f	6210 b -e	imported cultivar	
6620 a	5551 e f	7168 a b	7333 a b	7027 a- C	6018 C - e	local cultivar	Autumn season
6524 a	5769 d - f	6346 b - e	7170 a b	6894 a - d	6443 b - e	imported cultivar	

Averages with the same letter do not differ from each other morally, and their letters differ significantly from each other

Table (7): Effect of cultivars and weed control treatments on grain yield, kg.ha^{-1}, in the spring and autumn seasons in Nineveh province for the 2021 season.

cultivars average	cultivars × weed control treatments					treatments
	weed control treatments					
	control	free weeds	herbicide concentration 400	herbicide concentration 300	herbicide concentration 200	
9973 b	8620 d	11263 b d	10564 b - d	10151 C d	9268 d	local cultivar
12234 a	9709 C d	12399 a - C	14687 a	13174 a b	11199 b - d	imported cultivar
	9164 C	11831 a b	12626 a	11662 a b	10234 b C	Weed control treatments average

Seasons average	Seasons × weed control treatments						
10089b	8630 C	11081 a -C	11321a - C	10664 a -C	8750 C	spring season	
12117a	9699 b C	12581 a	13930a	12660 a	11717 a b	Autumn season	
Seasons × cultivars	Seasons × cultivars × weed control treatments						
8406 b	7008 d	10223 b - d	8747 C d	8645 C d	7410 d	local cultivar	spring season
11772 a	10252 b -d	11939 a -C	13895a b	12684 a -C	10091 b-d	imported cultivar	
11540 a	10231 b -d	12302 a -C	12382 a -C	11657 a -C	11126 b-d	local cultivar	Autumn season
12695 a	9167 C d	12860 a -C	15479a	13663 a b	12308 a -C	imported cultivar	

Averages with the same letter do not differ from each other morally, and their letters differ significantly from each other

Table (8): Effect of cultivars and weed control treatments on protein yield (gm) in plants for the spring and autumn seasons in Nineveh province for the 2021 season

cultivars average	cultivars × weed control treatments					treatments
	weed control treatments					
	control	free weeds	herbicide concentration 400	herbicide concentration 300	herbicide concentration 200	
13.06 a	10.66 C d	15.72 a b	14.43 a -C	12.84 a-d	11.66 C d	local cultivar
13.45 a	9.92 d	14.24 a -C	16.68 a	14.53 a -C	11.86 b-d	imported cultivar
	10.29 C	14.98 a	15.56 a	13.69 a b	11.76 b C	Weed control treatments average
Seasons average	Seasons × weed control treatments					

11.72b	9.76 d	13.51 a-d	13.18a -C	12.31 b - d	9.87 d	spring season	
14.77a	10.82 C d	16.45 a	17.91a	15.06 a b	13.64 a - d	Autumn season	
Seasons × cultivars	Seasons × cultivars × weed control treatments						
10.80 b	9.13 f g	13.94 a-g	11.33 b-g	10.85 C-g	8.76 g	local cultivar	spring season
12.65a	10.40 d-g	13.08 a-g	15.04a b	13.78 a-g	10.99 C- g	imported cultivar	
15.33 a	12.19 a-g	17.50 a	17.54 a	14.84 a-f	14.56 a-g	local cultivar	Autumn season
14.23a	9.44 e_g	15.41 a-d	18.29a	15.28 a-e	12.73 a-g	imported cultivar	

Averages with the same letter do not differ from each other morally, and their letters differ significantly from each other

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