Caspian Journal of Environmental Sciences
Online ISSN: 1735-3866
Print ISSN: 1735-3033

Effects of chemical herbicides and Datura leaves extract on the companion weed of two barley cultivars *Hordeum vulgare* L., the yield and its components

Rafid Ahmed Abbas Al-khaldy[1], Watheq Falhi Hammood[2], Suhad Mathkoor A. Safi[2]*

1. College of Agriculture, Al-Qasim Green University, Babylon, Iraq
2. College of Agricultural Engineering Sciences, University of Baghdad, Baghdad, Iraq

** Corresponding author's E-mail: suhadsafi7@uobaghdad.edu.iq.*

ABSTRACT

A field experiment was carried out to find out the effect of some chemical herbicides (Crash and U46), and Datura leaves extract (4 leaf age) on the companion weed of two barley cultivars (IPA 265 and IPA 99) and the yield and components of these two cultivars. The results showed the superiority of the two weed spraying (T_1) and the extract (T_2) treatments by giving the best results, as they recorded the lowest number of weeds after 30 days of spraying with 2.83 and 10.17 plants m^{-2}. Besides, the highest control percentage was 96.11% and 86.27% for the two treatments, respectively, compared to the control treatment (T_3; weedy), which gave the highest number of weeds after spraying 73.50 plants m^{-2}, while the lowest control percentage of 0.00%. Moreover, T_1 was superior by giving the best grain yield of 1.99 ton ha^{-1} and the highest weight of 1000 grains (48.88 g) as well as the highest number of grains per spike (43.57 grain $spike^{-1}$). T_1 exhibited a significant difference with T_2, which recorded a lower yield of 1.34 ton ha^{-1} and weight of 1000 grains (46.78 g), as well as the number of grains (33.17 grain $spike^{-1}$) and a number of spikes (313.3 spike per m^2). In comparison, the control treatment (T_3) recorded the lowest grain yield and the lowest weight of 1000 grains along with the lowest grain per spike, and the lowest number of spikes (1.00 ton ha^{-1}) as well as 36.72 g, 25.60 grain $spike^{-1}$ and 269.7 spikes m^{-2}, respectively. The two cultivars called IPA 99 and IPA 265, recorded a control percentage of 64.07% and 57.52%, respectively. There was a significant interaction in specific traits understudy for the two factors of the study, so that, T_1 and T_2 were superior with cultivars IPA 265 and IPA 99 by giving the best interaction in reducing the number of weeds after 30 days of spraying plant m^{-2}, coupled with the control percentage. Since, the cultivar IPA 99 and T_1 achieved the lowest number of weeds, i.e., 2.33 plant m^{-2} and the best control percentage reached 96.79%. However, the cultivar IPA 265 and T_1 achieved the best grain yield of 2.113 ton ha^{-1}. It can be concluded from this that spraying barley weeds with Datura leaves extract eliminated the weed, gave good control percentages, and increased the yield of barley grains and their components, with results close to what was achieved by the addition of the two herbicides.

Keywords: Chemical herbicides, Datura leaves, Companion Weed, *Hordeum vulgare* L.
Article type: Research Article.

INTRODUCTION

Barley, *Hordeum vulgare* L. is one of the important cereal crops cultivated in large areas in most parts of the world, which is one of the oldest cereal crops known in history and plays a vital role in the development of agriculture (Ullrich 2011). It can be used as food for humans after mixing it with wheat flour in a ratio of 1:3 for the hardness and consistency of the bread produced from its grains because it does not contain gluten and its bluish colour. Also, it is used as animal feed in the form of grains or green fodder or mixed with legume crops

Caspian Journal of Environmental Sciences, Vol. 20 No. 2 pp. 351-357 Received: Sep. 17, 2021 Revised: Nov. 09, 2021 Accepted: Feb. 26, 2022
DOI: 10.22124/CJES.2022.5567

Publisher: University of Guilan, Iran

to improve the nutritional value of the resulting fodder and its uses in industrial fields. It ranks fourth after wheat, rice, and maize in terms of production and cultivated area. Barley is also used in the production of malt, which is black honey extracted from barley grains. This honey is characterized by its high nutritional value, with an estimated amount of calcium, so it is used as a primary food against polio rickets and is used in some baking and candy-making processes, vinegar, yeast, and the remaining grains is used as animal feed (Al-Younes 1993). The average grain yield of the barley crop per unit area is much lower than the world production rate. The average yield per dunum is estimated based on the cultivated area (387.8 kg) for winter 2020. A decrease of 0.5% was noted compared to the last season, which was estimated at 408.1 kg (Directorate General Agricultural Statistics 2020). The weed is among the most dangerous agricultural pests because it causes a loss in production due to its direct competition with the agricultural crop or its indirect effects. The weed competes with crop plants with high efficiency for the most critical growth requirements such as water, light, and nutrients, especially in the early stages of its growth. As a result of this competition, the growth of crops, especially barley, is weak, leading to a decrease in its yield by 15-20% (O'Donovan *et al.*, 1985; Weston 2005; Anonymous 2019). Whereas Mahajan *et al.* (2020) found that the rate of yield decrease amounted to 43-70%, which resulted in increased harvest costs and poor grain quality. Therefore, appropriate and effective weed management strategies must be adopted, representing a significant challenge for crop producers since the beginning of cultivation (Suresha *et al.* 2015). Despite the efficiency of chemical herbicides in controlling the weed and its reflection on the yield and components, the damage caused by chemical herbicides from groundwater pollution is critical. Besides, the emergence of health problems due to the extensive and excessive chemical herbicides use and the long-term survival of herbicide residues in the soil led to many vital ecosystems in the long run. Thus, the phenomenon of Allelopathy in controlling the weed was invested, as the use of plant extracts, which are natural herbicides for the weed, has emerged. Identifying the allelopathic phenomenon in the weed has led to highlighting the possibility of exploiting it in the biological control of various agricultural pests. Intense efforts have been focused on the possibility of using various allelopathic extracts in the management of weed and inventing strategies for this purpose to reduce dependence on chemical herbicides harmful to the environment and health. Plus, the possibility of developing resistance to the weed and the emergence of strains resistant to herbicides. Based on the foregoing, many researchers began investigating weeds with high allelopathic effort as a first step to use allelopathic effort in controlling the weed. Several weed plants with high allelopathic effort were obtained as Datura plants; Jaber *et al*. 2019, indicated that Datura leaves contain the following compounds: alkaloids, condensed tannins, hydrolysable tannins, saponins, flavonoids, and steroids. These compounds have the ability to affect plants treated with them to different degrees. By conducting a comprehensive review on several studies in the field of Allelopathy, it can note that it has multiplied several times to continue its study by physiologists, plants, soils, weeds, and natural product chemists. The continued emergence of additional information about the mechanisms of the allelopathic compound's effect in terms of selectivity, secretion, persistence, and genetic regulation mechanisms constitutes a continuous challenge for botanists to develop modern strategies that enhance the protection of biodiversity (Cheng & Cheng 2015). Studies have indicated the presence of many weeds that showed an allelopathic effort in other crops that accompany them in the field or track them in agriculture. These weeds release allelopathic compounds to the environment by leaching, root exudates, the decomposition of plant residues by the action of microorganisms, and the method of volatilization. These compounds have inhibitory and stimulating effects on plants and microorganisms through their influence on many biological activities. Generally, the effects of allelopathic compounds depend on their nature and concentration, as some compounds cause inhibitory effects on seed germination and growth, while others cause stimulatory effects. However, Al- Chalabi (2003) indicated that using a mixture of 2,4-D + diclofop-methyl herbicide achieved the highest number of spikes of 314.7 spike m^{-2}, the highest weight of 1000 grains 34.8 g, and the highest grain yield of 4.415 ton ha^{-1} for the wheat crop. Similarly, Marwat *et al.* 2005, mentioned that the treatments of herbicide mixtures gave the highest weight of 1000 grains compared to the weedy treatment. (Kaur et al., 2018) mentioned that the addition of Sulfusulfuron at a rate of 25 g ha^{-1} with hand weeding treatment after 45 days of planting achieved the lowest number of weed plants m^2 and the highest control percentage % for the weed. Followed by the treatment of adding Clodinofop propargyl at a rate of 60 g ha^{-1} with the hand weeding treatment after 45 days of planting compared to the weedy treatment, which recorded the highest number and the lowest control percentage of weed plants. Furthermore, Pala (2020) showed that spraying pinoxaden 50 g L^{-1} EC 0.9 L h^{-1} and 2,4-D 2-ethylehexyle ester 452.42 g L^{-1} + Flurasulam 6.25 g L^{-1} SE 0.5 L

h^{-1} after emerging and mixing them led to a reduction in the number of narrow and broad-leaf weeds. It achieved the highest control percentage of 92% after 28 days of spraying, which increased barley yield. Hammood *et al.* 2020, indicated that the herbicides including Pallas (T_1) and Crash + U46 (T_2) recorded the lowest number of weed plants after 30 days of spraying, which were 1.44 and 1.67 plants m^{-2} respectively. The T_2 was superior by giving the highest control percentage of 93.28% compared to the control treatment T_3 (Weedy), which gave the highest number of weeds after spraying and the lowest control percentage of 21.56 plant m^{-2} and 0.00%, respectively. Treatment T_2 was superior by giving the best grain yield of 6.590 ton ha^{-1}, the highest weight of 1000 grains was 29.33 g, and the highest number of grains per spike was 52.02 grain $spike^{-1}$. It did not differ significantly from the treatment T_1 by giving the highest number of spikes m^{-2} amounted to 491.1 and 480. 0 spike m^{-2} for treatment T_1 and T_2 respectively, compared to the control treatment T_3, which gave the lowest grain yield and the lowest weight of 1000 seeds and the lowest grain per spike and the lowest number of spikes m^{-2} amounted to 4.819 ton ha^{-1} and 22.82 g and 43.27 grain $spike^{-1}$ and 378.8 spike m^{-2} respectively, and they indicated that the cultivars did not show any response or competitive ability for the companion weed to the oats crop. Mahajan *et al.* 2020; Watson *et al*. 2006; ABARES (2019) pointed out that the cultivars of barley crops, which are more susceptible to weed competition, are among the essential elements in integrated weed management. In the same role, Mahajan *et al*. 2020, explained the difference of plants of these cultivars in the number of spikes per (100 × 35) cm^2 which ranged between 46 and 80 spikes, and grain yield (Mg ha^{-1}), which ranged between 2.5 and 4.3 Mg ha^{-1}.

MATERIALS AND METHODS

A field experiment was carried out in the experimental field of the Department of Field Crops at the College of Agricultural Engineering Sciences, the University of Baghdad, Iraq during the winter season 2020-2021. The experimental study aimed to compare the effect of chemical weed herbicides (Crash U46) and the Datura leaves extract (four leaves aged) accompanied with weeds of two barley cultivars, the yield, and components of these two cultivars. The experiment was carried out according to a Randomized Complete Block Design (RCBD) with the split-plot arrangement in three replicates. The main plots represented two cultivars of barley crop to evaluate the performance of these two cultivars under different weed densities, where the cultivars are IPA 265 and IPA 99. As for the sub-plots, it included the weed control treatments as follows:

1. A combination of Crash + U46, at a spraying rate of 1 L ha^{-1} for each herbicide (T_1).
2. Datura leaves extract at a spraying rate of 15 L ha^{-1} (T_2).
3. Weedy treatment, as the weeds were left to compete with the crop throughout the growing season (T_3).

Extraction of allelopathic compounds

After taking the samples, the leaves (4 leaves aged) were dried, crushed, and analysed in the laboratories of the Ministry of Science and Technology using a German-made HPLC device (SYKAM) and according to the method of Eddine & Ridha (2017). Thus, the Datura leaves extract was prepared at a concentration of 5%, where the analysis results are shown in Table 1.

Table 1. The amount of phenolic acids measured in mg g^{-1} unit.

Name	Total Phenolic Content (mg Gallic g^{-1})
Datura plant (four leaves aged)	60.12

The soil service operations were carried out, and the field was divided into three replicates. Both barley cultivars seeds were sown on 26/11/2020 at a seeding rate of 120 kg ha^{-1} in rows with 20 cm distance between one row and another. Then, the experimental land was fertilized with triple phosphate fertilizer (P_2 O_5 46%) at a rate of 100 kg ha^{-1} before planting. Urea fertilizer (N 46%) was added at a rate of 200 kg N ha^{-1} in three batches, the first batch was added at the beginning of the tillering stage, the second at the beginning of the elongation stage, and the third at the booting stage (Jaddoa & Saleh 2012). The two herbicides were sprayed after 45 days of planting on the shoot of crop and weed for each treatment using water as a spray solution of 200 L ha^{-1}, specifically at the beginning of the tillering stage. The spraying was carried out using a 16-liter knapsack sprayer under a pressure of 2.8 kg cm^{-2} for each experimental unit, according to the concentrations under study. The Datura leaves extract was sprayed at the same time as the two herbicides were sprayed.

The companion weed has been studied as follows:

1- Weed species and their density (plant m^{-2}):

The weed species were identified, and their density was calculated before spraying and after 30 days of spraying by identifying and calculating the number of weeds per m^2 of the experimental unit.

2- The percentage of weed control:

It was calculated according to the following equations (Al-Chalabi 2003):

$$\text{Control (\%)} = \frac{\text{weed density in the comparison treat.} - \text{weed density in the control treat.}}{\text{weed density in the comparison treat}} \times 100$$

The treatments effect on the yield and its components was studied as follows:

1-The number of spikes m^{-2}

2-The number of grains $spike^{-1}$

3-The weight of 1000 grains (g)

4-Total grain yield (ton ha^{-1}):

After conducting the threshing process of the sample harvested from an area of one square meter, the straw was separated, and the grains were weighed, then the weight was converted to ton ha^{-1} (AOAC 1975).

Statistical analysis

Data were collected and tabulated for the traits under study and then were statistically analysed according to the split-plot arrangement by RCBD design using the GEN STAT program. Then, the arithmetic averages of the treatments were compared using the least significant difference (LSD) with a probability level of 0.05 (Steel & Torrie 1980).

RESULTS AND DISCUSSION

The effect of different treatments on the companion weed to barley

When identifying the weed species spread during the growing season, the number of weed species reached 14, including 13 broad leaves (Table 1). Among the weed species, Henbit deannettle, London roket, white goosefoet, and Button weed were the most prevalent among other weed species. At the same time, there were small numbers of Common sow thistle, Milk thistle, Wild carrot, Toothed medic, White top, Petty spurge, Wild beets, and Wort weed. In the case of the narrow-leaves weeds, including the Canary grass, the percentage was generally much lower compared to the broad-leaves ones. Table 3 indicates significant differences for the different treatments, as T_1 and T_2 achieved the lowest number of weeds after 30 days of spraying (2.83 and 10.17 plant m^{-2} respectively). Besides, the highest control percentages were 96.11% and 86.27% for the two treatments respectively, compared to the control treatment (weedy), which gave the highest number of weeds and the lowest percentage of control (73.50 plant m^{-2} and 0.00% respectively). Due to the herbicides effectiveness and the extracts used a difference in the number of weeds was also recorded before and after 30 days of spraying.

It is noticed from Table 3 that there are significant differences between the cultivars in the control percentage only, as the cultivar IPA 99 exceeded by giving the highest control percentage of 64.07%. In contrast, the cultivar IPA 265 recorded the lowest control percentage of 57.52%, while there were no significant differences for the other treatments. Table 4 shows significant differences in the yield and components for the control treatments and the barley cultivars used in the experiment.

The two cultivars did not differ significantly in the yield and component characteristics except for the number of spikes m^{-2}, where the cultivar IPA265 achieved the highest number of 383.3 spike m^{-2}, followed by the cultivar IPA99 recording 292.60 spike m^{-2}. However, T_1 was superior by giving the best grain yield (1.99 ton ha^{-1}) and the highest weight of 1000 grains (48.88 g) as well as the highest number of grains per spike (43.57 grain $spike^{-1}$) and the highest number of spikes per cubic meter (430.80 spike m^{-2}), followed by T_2, which recorded the lowest yield of 1.34 ton ha^{-1}, the weight of 1000 grains (46.78 g), the number of grains (33.17 grain $spike^{-1}$), and the number of spikes (313.3 spike m^{-2}). The superiority of T_1 is as a result of elevating the two components of the yield (the weight of 1000 grains and the number of grains per spike), which increased the total yield. Besides, any increase in any crop component is only a reflection of the herbicide effectiveness in reducing the number of weeds (Table 3), which allowed the crop to grow better and more efficiently exploit the growth requirements.

Table 2. Species of weed growing in the experimental land during the winter season 2020-2021.

English name	Scientific name	Family name	Type	Life cycle
Button weed	*Malva rolundifolia* L.	Malvaceae	Broad-leaves	Annual
Milk thistle	*Silybum marianum* (L) Gaertn	Campositeae	Broad-leaves	Annual
White goosefoet	*Chenopodium album* L.	Chenopodiaceae	Broad-leaves	Annual
London roket	*Sisymbrium irio* L.	Cruciferae	Broad-leaves	Annual
Petty spurge	*Euphorbia peplus* L.	Euphorbiaceae	Broad-leaves	Annual
Wild carrot	*Daucus carota* L	Umbellifereae	Broad-leaves	Annual
Wild beets	*Beta vulgaris* L.	Chenopodiaceae	Broad-leaves	Annual
Common sow thistle	*Sonchus oleraceus* L.	Campositeae	Broad-leaves	Annual
Henbit deannettle	*Lamium amplexicauule* L.	Labiatae	Broad-leaves	Annual
Wort weed	*Euphorbia helioscopia L*	Euphorbiaceae	Broad-leaves	Annual
Toothed medic	*Medicago hispida* L.	Fabaceae	Broad-leaves	Annual
White top	*Cardaria draba* (L)Desv	Cruciferae	Broad-leaves	Annual
Canary grass	*Phalaris minor* L.	Poaceae	Narrow-leaves	Annual

Table 3. The effect of different treatments on the characteristics of weed.

Properties / Treatments		Weed numbers plant m^{-2} Before spraying	Weed numbers plant m^{-2} after spraying	The control percentage (%)
IPA 265		75.33	31.44	57.52
IPA 99		76.44	26.22	64.07
LSD: 0.05		N.S	N.S	4.977
T_1		78.33	2.83	96.11
T_2		74.33	10.17	86.27
T_3		75.00	73.50	0.00
LSD: 0.05		3.254	3.246	3.184
IPA 265	T_1	76.33	3.33	95.42
	T_2	75.00	17.00	77.13
	T_3	74.67	74.00	0.00
IPA 99	T_1	80.33	2.33	96.79
	T_2	73.67	3.33	95.42
	T_3	75.33	73.00	0.00
LSD: 0.05		NS	5.570	4.468

* Note: T_1 / Crash + U46 herbicide combination at a spraying rate of 1 L ha^{-1} for each herbicide. T_2 / Datura leaves extract at a spraying rate of 15 L ha^{-1}. T_3 / weedy treatment.

Table 4. The effect of different treatments on the yield and its components.

Properties / Treatments		Number of spike m^{-2}	Number of grains $spike^{-1}$	Weight of 1000 grain (g)	Grain yield ton ha^{-1}
IPA 265		383.3	32.82	46.09	1.5033
IPA 99		292.6	35.40	42.17	1.3911
L.S.D 0.05		16.28	N.S	N.S	N.S
T_1		430.8	43.57	48.88	1.9933
T_2		313.3	33.17	46.78	1.3483
T_3		269.7	25.60	36.72	1.0000
LSD: 0.05		15.77	3.791	2.623	0.04856
IPA 265	T_1	480.0	43.93	49.60	2.1133
	T_2	358.3	29.47	49.13	1.3867
	T_3	311.7	25.07	39.53	1.0100
IPA 99	T_1	381.7	43.20	48.17	1.8733
	T_2	268.3	36.87	44.43	1.3100
	T_3	227.7	26.13	33.90	0.9900
LSD: 0.05		NS	NS	NS	0.11881

* Note: T_1 / Crash + U46 herbicide combination at a spraying rate of (1) L ha^{-1} for each herbicide. T_2 / Datura leaves extract at a spraying rate of (15) L ha^{-1}. T_3 / weedy treatment.

Furthermore, the lowest results of weedy treatment resulted from the weeds competing with the crop throughout the growing season on the basic growth requirements such as water, nutrients, and light. This competing contributed to restricting plant growth and decreasing the efficiency of the physiological processes within its tissues, especially the process of photosynthesis. Then, a reduced metabolic products and a decreased plant efficiency in the transfer of these products to the reproductive parts of the plant, resulted in a restriction in the number and capacity of sinks, and then a drop in the grain yield (Hammood *et al.* 2020). However, the cultivar IPA 265 recorded the highest number of spikes m^{-2} because of its genetic nature or its response to environmental conditions. Tables 3 and 4 showed that there is a significant interaction in certain traits for the studied factors, so that, T_1 and T_2 exceeded with IPA 265 and IPA 99 by giving the best combination in reduced number of weeds after 30 days of spraying plant m^{-2} and the control percentage. Moreover, IPA 99 with T_1 achieved the lowest number of weeds (2.33 plant m^{-2}), and the best control percentage (96.79%). The cultivar IPA 265 with T1 achieved the best grain yield (2.113 ton ha^{-1}). According to Tables 3 and 4, the close results between T_1 and T_2 indicate the role of plant extracts in reducing the number of companion weeds to the crop and their role in reduced environmental pollution. This may be due to the fact that the extract contains allopathic compounds (Table 1), which at high concentrations affect cell division, hormone biosynthesis, element absorption (Rizvi *et al.* 1992) and cell membrane permeability (Harper & Balke 1981). Photosynthesis, the mechanism of stomata opening and closing (Einhellig & Rasmussen 1979), as well as respiration and protein metabolism (Kruse *et al.* 2000) negatively affects weed growth and thus reduce their numbers. It can be concluded that the Datura leaves extract has given averages close to the effect of herbicides in reducing the number of weeds with a high control percentage. Even the presence of different varieties increased the yield and its components, confirming the role of integration between the effect of each cultivar, herbicides, and the Datura leaves extract in controlling the companion weed to the barley crop.

REFERENCES

Wei, B, Su, G, Li, Y & Ma, Y 2019, Livelihood Strategies of Rural Households in Ning'er Earthquake-Stricken Areas, Yunnan Province, China. *Sustainability*, *11*: 1–18.

WWF 2016, Building Back Safer and Greener: A Guide to Sound Environmental Practices for Disaster Recovery in Nepal. WWF, Nepal. ABARES Australian Crop Production 2019, ABARE Australian Crop Report, September 2018. *Australian Bureau of Agricultural and Resource Economics Sciences*, 187: 17. Available online: http://www.agriculture.gov.au /abares /research topics/agricultural-commodities/ Australian-crop-report (accessed on 4 October 2019).

AOAC 1975, Official methods of analysis, association of official analytical chemists. Washington DC, USA, 41: 42-48.

Al Chalabi, FT 2003, Biological response of wheat to weeds control with Diclofop- methyl herbicide sequentially with 2,4-D and its effect on grain yield. *Journal of Iraqi Agricultural Science*, 34:89-100.

Al Younes, AHA 1993, Production and improvement of field crops (part one). Ministry of Higher Education and Scientific Research, College of the Agriculture, University of Baghdad.

Anonymous 2019, Alberta barley. Accession Date: 21 August 2019. Available from: https://www.albertbarley.com/our- priorities/barely/production/weeds/. Bulletin, 29: 1206-1213.

Cheng, F & Cheng, Z 2015, Research progress on the use of plant allelopathy in agriculture and the physiological and ecological mechanisms of allelopathy. *Frontiers in Plant Science,* 6: 1020.

Ciba-Geigy Agrochemicals Division 1975, Field Trial Manual. Ciba-Geigy, SA, Basle, Switzerland.

Directorate General Agricultural Statistics, 2020, Wheat and barley production. Central Statistical Organization, Ministry of Planning, Republic of Iraq.

Eddine, LS & Ridha, OM 2017, Phytochemical screening in vitro antioxidant and antibacterial activity of *Rumex vesicarius* l. extract. *Scientific Study and Research: Chemistry and Chemical Engineering,* 18:367-376.

Einhellig, FA & Rasmussen, JA 1979, Effects of three phenolic acids on chlorophyll content and growth of soybean and grain sorghum seedlings. *Journal of Chemical Ecology,* 5:815-824.

Hammood, WF, Al khafaji, MJ & Safi, SMA 2020, The effect of some herbicides on the companion weeds to three cultivars of oats. *International Journal of Agricultural and Statistical Sciences*, 16: 1527-1532.

Harper, JR & Balke, NE 1984, Characterization of the inhibition of k+ absorption in oat roots by salicylic acid. *Plant Physiology,* 68:1349-1353.

Jaber, A, Al Harakeh, L, Ibrahim, G & Cheble, E 2019, Phytochemical study and antioxidant activity of extract from the leaves of Lebanese *Datura metel* L. *European Journal of Pharmaceutical and Medical Research*, 6: 65-71.

Jaddoa, KA, Saleh, HM 2012, Fertilization of wheat crop. Indicative Bulletin No. 2, Ministry Of Agriculture, National Program for the Development of Wheat Cultivation in Iraq, 11 p.

Kaur, A, Kumar, S, Singh, N & Kaur, M 2018, Effect of different herbicides on weeds and growth of barley (*Hordeum vulgare* L) in central Punjab. *Agriways,* 6: 37- 40.

Kruse, M, Strandberg, M & Strandberg, B 2000, Ecological effects of allelopathic plant: A review. 66 p. National Environmental Research Institute (NERI), Technical Report No. 315, Silkeborg, Available online at: http//www2.dmu.dk/1_viden/2_publikationer/3…/rapporter/fr315.pdf.

Mahajan, G, Hickey, L & Chauhan, BS 2020, Response of barley genotypes to weed interference in Australia. *Agronomy,* 10: 99.

Marwat, KB, Hussain, Z, Saeed, M, Gul, B & Noor, S 2005, Chemical weed management in wheat at higher altitudes. *Pakistan Journal of Research in Weed Science,* 11: 102-107.

O'Donovan, JT, Remy, EADS, o'sullivan, PA, Dew, DA, Sharma, AK 1985, Influence of the relative time of emergence of wild oat (*Avena fatua*) on yield loss of barley (*Hordeum vulgare*) and wheat (*Triticum aestivum*). *Journal of Research in Weed Science*, 33: 498-503.

Pala, F 2020, The effect of post-emergence herbicides and their mixtures on grass and broad-leaf weed control in barley (*Hordeum vulgare* L.). *Fresenius Environmental Bulletin,* 29: 1206-1213

Rizvi, SJH, Haque, H, Singh, VK & Rizvi, V 1992, A discipline called allelopathy. In: allelopathy basic and applied aspects. Chapman &Hall, London, pp: 1-10.

Steel, RGD & Torrie, JH 1980, Principles of Statistics. McGraw-Hill Book Company Incorporated New York, USA, 485 p.

Suresha, K, Ashish RSS, Negi, SC & Kumar, S 2015, Assessment of yield and nutrient losses due to weeds in maize-based cropping systems. *Himachal Journal of Agricultural Research,* 41: 42-48.

Ullrich, SE 2011, Barley: production, improvement, and uses. Wiley-Blackwell, Ames, IA, USA, 637 p.

Watson, PR, Dirksen, DA, Van Acker, RC 2006, The ability of 29 barley cultivars to compete and withstand competition. *Weed Science,* 54: 783-792.

Weston, IA 2005, History and future perspectives of allelopathy for weed management. *Horticultural Technology*, 15:529- 534.

Bibliographic information of this paper for citing:

Al-khaldy, R,A,A, Hammood, W,F, A. Safi, S,M 2022, Effects of chemical herbicides and Datura leaves extract on the companion weed of two barley cultivars *Hordeum vulgare* L., the yield and its components. Caspian Journal of Environmental Sciences, 20: 351-357.