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# Effect of Spraying with Water Hyacinth and Silverleaf Extractson Growth and Yield of Sunflower (*Helianthus annuus* L.)

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**Abstract.** A field experiment was carried out in one of the special fields Al-Jazirah - Al-Budhiyab located at latitude 38.28° north and longitude 43.19° east, to find out the effect of different concentrations of the extract of the Water hyacinth and silverleaf plants in three varieties of sun flower. The experiment was applied using a split-plate arrangement within an RCBD design with three replications. The main plots were represented by the varieties Ishaqi, Sakha, and Iqmar, and the sub plots included the spray concentrations 0, 5, 15 and 25 mg L<sup>-1</sup>. The results showed that the Iqmar variety was superior in plant height (179.73 cm) in the spring season, and the cultivar Ishaqi (175.50 cm) in the fall season. The variety also outperforms generously in leaf area (307.4 cm<sup>2</sup>) in the fall season. As for the extracts, the water hyacinth outperformed the plant height (177.74 and 175.11 cm) in both seasons, respectively. And in the stem diameter (20.45 mm) in the spring season and in the dry weight of the weeds (0.045 and 0.053 g m<sup>2</sup>) in both seasons respectively. While silverleaf herb extract exceeded the leaf area (213.9 and 271.1 cm<sup>2</sup>) in both seasons sequentially and the stem diameter (20.86 mm) in the fall season, the silverleaf herb extract reduced the dry weight of the weeds (0.032 and 0.043 g m<sup>2</sup>) in both seasons respectively. He increased the weight of 1000 seeds (59.25 and 67.20 grams) in both seasons and the total yield (3.26 ton ha<sup>-1</sup>) in the fall season. The 15 mg L<sup>-1</sup> concentration also increased plant height (180.02 cm) and leaf area (208.9 cm<sup>2</sup>) in the spring season, disc diameter (22.39 cm) in the fall season and the number of seeds (924 seeds per disc<sup>-1</sup>). While the concentration increased plant height (176.19 cm) and leaf area (276.8 cm<sup>2</sup>) in the fall season. The concentration outperformed 5 mg L<sup>-1</sup> in stem diameter (19.65 and 20.32 mm) in both seasons and increased the weight of 1000 seeds (59.57 and 67.94 g) in both seasons sequentially and the overall yield (4.35 and 3.18 ton ha<sup>-1</sup>) in both seasons. Sequentially. We conclude that there is a fluctuation in the behavior of the same crop varieties due to the overlap of study factors and in different directions, so it is recommended to individualize the factors in their influence on the varieties to know the behavior of those varieties more accurately.

## 1. Introduction

The sunflower *Helianthus annuus* L. is one of the most important oil crops, as it ranks first in terms of oil yield, as its seeds contain a high percentage of it, estimated at more than 50%, depending on the cultivar used. And because it contains Omega3 fatty acids, it is an important food for humans, as it has no side effects on human health, as well as being rich in unsaturated fatty acids such as Oleic acid and Linoleic acid and vitamins A, D and E, in addition to containing a high percentage of its gain. Of



protein 36% and carbohydrates 20-22%, so it is a great fodder for animals and poultry. Its fields are used for beekeeping [1]. The productivity rate of sunflower in Iraq is still low despite its importance and multiple nutritional uses for humans and animals, as its productivity rate reached 2.11 ton ha<sup>-1</sup> compared to global production, which reached 7.5 ton ha<sup>-1</sup> [2]. Water hyacinth consider whose scientific name is *Eichhornia crassipes*, is one of the floating water weed plants of the Pontindraceae family, and it is from the weeds that were introduced to Iraq, and it has spread in several areas of it. The diversity of weed plants has great negative effects on crop growth and yield reduction, especially those invasive weeds such as silverleaf grass and introduced as the water hyacinth. These two weeds have become dangerous weeds in the crop environment in Iraq [3]. As for the herb of the silverleaf, whose scientific name is *Solanum elaeagnifolium*, it is from the invasive terrestrial weeds to the environment in Iraq and belongs to the Solanaceae family, as it is found in many areas of western Iraq [4]. Wild silverleaf has allelopathic effects that enable it to compete with some field crops by inhibiting growth and development [5]; [6]. Balah, et al.[7] found that this herb may adversely affect the growth of some weeds associated with the wheat crop, and the reason for this plant to have lelopathic effects is that it contains secondary active compounds such as alkaloids [5]; [8] Flavonoids and clacosides [9];[10] and phenolic compounds such as gallic acid and chloroginc [11]and [12,13,14]. The concentration of these active compounds may increase with the effect of some mechanical stress, as it may be caused by an increase in caryophyllene compounds [15]. The vegetative parts of the wild nightshade also contain Saponins and glycosidic alkaloids such as-solamarine [16]. Solanum may contain For which the wild nightshade plant follows Coumarin, Steroids, and terpenoids [17]. As for the allelopathic effects resulting from the Water hyacinth herb, as many studies have shown that this plant possesses these inhibitory effects against some aquatic plants and algae. [18]; [19] indicated the influence of *Microcystis aeruginosa*, as it was found that This herb has inhibitory effect against this alga with different densities, especially in low densities, which led to inhibition of this algae by 95.6% at density (OD 650 = 0.10) and 97.3% at density (OD 650 = 0.05). Methanolide from dry roots inhibited the growth of algae and increased the inhibitory effect by increasing the concentration of the crude extract indicating that this herb releases inhibitory substances from the root system, which showed an allelopathic effort against the algae *Microcystis aeruginosa*. Also, Water hyacinth extracts may have inhibitory effects against the growth of cress, wood, jet, Timothy grass and rye [20], and Water hyacinth herb extract inhibited the germination of wild oats and milk thistle seeds [21]. The reason that the Water hyacinth possesses these inhibitory properties may be attributed to its excretion of inhibitory substances from the root system [18] such as loliolide [20] as well as some aromatic compounds produced by the Shikimic acid pathway [22]. And anthraquinone [23] and N-phenyl-2-naphthylamine [19]. It has also been found in other studies that Water hyacinth herb may possess allelopathic properties that stimulate against germination of seeds such as *Pinus roxburghii* and *Bauhinia purpurea* [24]. Mashavira, et al. [25] found that Water hyacinth herb may increase yield for some crops due to its large biomass that is used to stimulate organic compounds. Therefore, the Water hyacinth may be a green plant for the manufacture of some effective compounds important to the plant [26]; [27] and converting them into energy at the lowest cost [4]. The use of chemical manufactured compounds led to environmental and health damages, as these substances affect the environmental balance and cause deadly diseases, which led to an increase in demand and voices raised for the use of sustainable agriculture and environmentally friendly alternatives instead of manufactured chemical compounds, so the agricultural allelopathic antagonism is the successful alternative to using these (Pesticides) in crop and forest management and control and reduce the excessive use of synthetic jungle pesticides or industrial growth regulators. Among the effects of allelopathic antagonism affect the synthesis of chlorophyll and inhibit cell division, plant hormones production and membrane permeability, so this study came with the aim of determining the negative or positive response of some varieties of sunflower to the extract of the Water hyacinth and silverleaf and determining the stimulating or inhibiting concentration in the growth and yield of the crop, and the associated weeds.

## 2. Materials and Methods

### 2.1. Materials

A Field experiment was carried out in one of the private fields in the Al-Budhiyab region – Jazerat al-Ramadi, which is located at latitude 38.28° North and longitude 43.19° East, and on the banks of the Euphrates River in the spring and fall seasons of 2020. To study the spraying of plant extract of the two weeds; the Water hyacinth (*Eichhorinia crassipes*) and silverleaf (*Solanum elaeagnifolium*) and their effect on the growth and yield of three cultivars of sunflower and the associated weeds. The experiment was applied using complete randomized blocks RCBD with randomly distributed split-split plots arrangement. The main plots included three cultivars Ishaqi, Sakha, and Iqmar. weeds type, Water hyacinth and silverleaf, represented the sub plots. The sub-sub plots involved concentrations with plant extract 0, 5, 15, 25 mg L<sup>-1</sup>. These concentrations were prepared after drying each plant extracts via taken 5, 15 and 25 mg from dry extract and dissolved in 1000 ml distilled water, for each concentration, respectively. The number of experimental units 72 units resulting from the combination of study factors with three replicates. Several concentrations of the extract obtained from the two weeds were prepared at the concentrations specified in the study, which are 0, 5, 15 and 25 mg L<sup>-1</sup> and the symbol for Water hyacinth (T1) and for the silverleaf plant (T2). The solution of each concentration was sprayed on the plants until the leaves of the plant were absorption in the early morning using a 16-liter sprayer, a diffuser (Dishwashing liquid) was added to the spray solution by 3 cm<sup>3</sup> per 20 liters, to reduce the surface tension of water and to ensure complete wetness, as for its treatment. In comparison, it was sprayed with distilled water only, as the weed extract was sprayed at the stage of four leaves. Field study was attended by ploughing, levelling and smoothing, then it was divided into plots, the area of plots amounted to 4 \* 3 m<sup>2</sup>, each plot contained seven rows, the distance between each two rows 50 cm and between plants and each other 25 cm.

### 2.2. Extracts preparation

100 grams of aboveground parts were weighed for each weed and placed in an electric mixer, 200 ml of methanol was added to it and mixed with a shaker mixer, for 25 minutes, then the mixture was transferred to a beaker and tightly covered with plastic paper and then left for an hour in order to precipitate the extractant in it, then separate the scent from the extract of the two weeds from the sediment material (marc) with a dull cloth and purify the scent extract again by passing through a filter paper (no:1) placed in the Buchner funnel. appropriate amount of the extract from each weed was prepared, resulting extract of 100% full-strength. The plant extracts were kept in 0±2°C to protect the extract and prevent microbial deterioration. The extraction process was repeated several times to prepare an appropriate and sufficient quantity of the extract. The data were recorded on plant height (cm), leaf area (cm<sup>2</sup>), stem diameter (mm), dry weight of weeds at harvest (g m<sup>2</sup>), Disk Diameter (cm), number of seeds per disc (seed per disc<sup>-1</sup>), weight of 1000 seeds (g) and total yield (ton ha<sup>-1</sup>).

### 2.3. Statistical analysis

Data were analysed according to analysis of variance according to the design of randomized main plot in the arrangement of split-split design using the least significant difference test ( $P \leq 0.05$ ) to statistically compare the arithmetic averages at a probability concentration of 0.05 [28] and using the statistical program (Genstat-2014).

## 3. Results and Discussion

### 3.1. Plant height (cm)

The results of Table (1) show the effect of spraying with plant extracts of Water hyacinth and silverleaf herbs on plant height (cm) of sun flower. The results showed that there were significant differences between the varieties in the spring and fall season, as the variety gave the highest average Iqmar for plant height of 179.73 cm, while the variety gave the lowest average plant height, which

amounted to 171.35 cm in the spring season. In the fall season, Ishaqi cultivar gave the highest average plant height, which was 175.50 cm, while Sakha and cultivar gave lower mean Iqmar for plant height of 169.76 and 169.78 cm for the two varieties respectively.

Table 1. Effect of spraying with plant extract of Water hyacinth and silverleaf herbs on plant height (cm) for sunflower.

cultivars	weeds	Spring 2020 concentration mg L <sup>-1</sup>				mean	Fall 2020 concentration mg L <sup>-1</sup>				mean
		0	5	15	25		0	5	15	25	
Ishaqi	Silverleaf	175.53	162.10	198.13	159.87	173.46	195.57	170.25	157.00	166.83	175.50
	Water hyacinth	162.87	169.10	173.67	186.43		184.67	166.67	171.33	191.67	
Iqmar	Silverleaf	178.53	170.00	186.07	165.20	179.73	135.33	171.00	172.17	181.67	169.78
	Water hyacinth	184.53	199.87	183.63	170.00		190.33	177.17	165.93	164.67	
Sakha	Silverleaf	197.07	142.87	160.87	167.17	171.35	162.87	165.00	175.00	166.33	169.76
	Water hyacinth	177.10	175.43	177.73	172.53		160.33	156.67	185.87	186.00	
P≤ 0.05		14.10				6.73	12.97				4.66
cultivars	Ishaqi	169.20	165.60	185.90	173.15		190.12	168.46	164.17	179.25	
	Iqmar	181.53	184.93	184.85	167.60		162.83	174.08	169.05	173.17	
	Sakha	187.08	159.15	169.30	169.85		161.60	160.83	180.43	176.17	
P≤ 0.05		12.63					9.90				
weeds	Silverleaf	183.71	158.32	181.69	164.08		164.59	168.75	168.06	171.61	
	Water hyacinth	174.83	181.47	178.34	176.32		178.44	166.83	174.38	180.78	
P≤ 0.05		8.12					7.49				
mean		179.27	169.89	180.02	170.20		171.52	167.79	171.22	176.19	
P≤ 0.05		7.29					6.25				
cultivars	Ishaqi	weeds					weeds				
		Silverleaf	173.91	Water hyacinth	173.02	Silverleaf	172.41	Water hyacinth	178.58		
	Iqmar	Silverleaf	174.95	Water hyacinth	184.51	Silverleaf	165.04	Water hyacinth	174.52		
		Sakha	166.99	Water hyacinth	175.70	Silverleaf	167.30	Water hyacinth	172.22		
P≤ 0.05		7.03				N.S					
mean		171.95	177.74	168.25	175.11						
P≤ 0.05		4.10				3.74					

The results of the same table also indicated that there were significant differences between the species in the spring and fall seasons, as the Water hyacinth gave the highest average plant height in the spring and fall seasons, which reached 177.74 and 175.11 cm for the two seasons respectively. While silverleaf gave the lowest mean for plant height, which was 171.95 and 168.25 cm for the spring and fall seasons respectively. As for the concentrations, the results indicated that there were significant differences between them in the spring and fall seasons, as the concentration gave 15 mg L<sup>-1</sup> in the spring season and the concentration was 25 mg L<sup>-1</sup> in the fall season. The highest average plant height reached 180.02 and 176.19 cm for the two seasons and for the two concentrations, respectively. While the concentration of 5 mg L<sup>-1</sup> in the spring and fall seasons gave the lowest average for the trait, which reached 169.89 and 167.79 cm for the two seasons respectively. The results of the bilateral overlap between the varieties and species showed that there were significant differences between them in the spring season, while there were no significant differences between them in the fall season. The double overlap between Iqmar and silverleaf gave the highest average plant height of 174.95 cm, which was not significantly different from the Ishaqi variety, which gave 173.91 cm. While the variety Sakha and silverleaf gave the lowest average plant height of 166.99 cm. Whereas, the bilateral interaction between the variety Iqmar and the Water hyacinth gave the highest average plant height of 184.51 cm. While the interaction between the variety Ishaqi and the Water hyacinth gave the lowest average for the trait, which was 173.02 cm. The results of the bilateral overlap between species and concentrations

also showed that there were significant differences between them in the spring and fall seasons, as silverleaf and concentration  $0 \text{ mg L}^{-1}$  gave the highest average plant height of 183.71 cm. While silverleaf and concentration  $5 \text{ mg L}^{-1}$  gave the lowest mean for the trait, which was 158.32 cm. While the Water hyacinth and the concentration of  $5 \text{ mg L}^{-1}$  gave the highest average plant height of 181.47 cm. While the Water hyacinth and the comparison treatment ( $0 \text{ mg L}^{-1}$ ) gave the lowest mean for the trait, which was 174.83 cm. In the fall season, silverleaf and Water hyacinth herb at spraying level of  $25 \text{ mg L}^{-1}$  gave the highest average plant height of 171.61 and 180.78 cm for the two herbs, respectively. While the silverleaf herb, when compared to the comparison treatment, and the Water hyacinth herb at a concentration of  $5 \text{ mg L}^{-1}$  gave the lowest average plant height of 164.59 and 166.83 cm for the two herbs and for the two concentrations, respectively. The results of the bilateral overlap between the varieties and the concentrations indicated that there were significant differences between them in the spring and fall seasons. As the variety gave Sakha when the comparison treatment ( $0 \text{ mg L}^{-1}$ ) the highest average plant height reached 187.08 cm. Whereas, the cultivar gave Ishaqi and the concentration of  $5 \text{ mg L}^{-1}$ , the lowest average for the trait was 165.60 cm in the spring season. In the fall season, the cultivar gave Ishaqi and the comparison treatment ( $0 \text{ mg L}^{-1}$ ), the highest average plant height was 190.12 cm. While the variety gave generous and spray concentration of  $5 \text{ mg L}^{-1}$ , the lowest average for the characteristic was 160.83 cm. As for the results of the triple overlap between varieties, species and concentration, the results show that there are significant differences between them in the spring and fall seasons. The variety Ishaqi and silverleaf had a concentration of  $15 \text{ mg L}^{-1}$ , which reached 198.13 cm. While the variety Sakha and silverleaf and the concentration of  $5 \text{ mg L}^{-1}$  gave the lowest average plant height of 142.87 cm for the spring season. In the fall season, the triple overlap between the variety Ishaqi and silverleaf and the concentration ( $0 \text{ mg L}^{-1}$ ) gave the highest average plant height of 195.57 cm. While the cultivar gave Iqmar and silverleaf, and the comparison treatment had the lowest average plant height of 135.33 cm. the effect of the extracts of plant species differs according to certain factors, including those that may be genetic and that affect the content of plants from the active compounds produced and thus their allelopathic ability in other plant species may inhibit cell division and elongation and the activity of responsible enzymes. On a number of chemical processes inside plants and this is in agreement with [29]; [30] who diagnosed these compounds as phenolic compounds and that these compounds differ in their distribution ratios from one plant to another. The genotypes of the varieties may differ in their response to the allelopathic properties of the weeds due to the extracts containing a wide range of active compounds that may adversely affect the growth of these crops [31].

### 3.2. leaf area ( $\text{cm}^2$ )

The results of Table (2) indicate the effect of spraying with plant extracts of Water hyacinth and silverleaf herbs on the leaf area ( $\text{cm}^2$ ) of sun flower. The table shows that there are no significant differences between varieties in the spring season, while there are differences between them in the fall season. As the cultivar gave the highest average leaf area of  $307.4 \text{ cm}^2$ , while the variety gave the lowest average Iqmar for the leaf area, which amounted to  $249.3 \text{ cm}^2$ . The results of the same table showed that there were significant differences between the types of extracts in the spring season only, as silverleaf gave the highest average leaf area of  $213.9 \text{ cm}^2$ . While the Water hyacinth herb gave the lowest average leaf area of  $200.0 \text{ cm}^2$ . The concentrations of extracts were not significant in both seasons. The results show that there are significant differences between spray concentrations in the spring and fall seasons. The comparison treatment ( $0 \text{ mg L}^{-1}$ ) in the spring and fall seasons gave the highest average paper surface area of 225.7 and  $293.1 \text{ cm}^2$  for the two seasons, respectively. Whereas, the concentration of  $25 \text{ mg L}^{-1}$  in the spring season and the concentration of  $5 \text{ mg L}^{-1}$  in the fall season gave the lowest average for the leaf area was 190.8 and  $242.1 \text{ cm}^2$  for the two seasons respectively. The results of the bilateral overlap between the varieties and species also showed that there were no significant differences in the fall season, while there were significant differences between them in the spring season. Sakha and silverleaf gave the highest average leaf area of  $234.9 \text{ cm}^2$ . Whereas, the bilateral overlap between the Iqmar and silverleaf gave the lowest mean for the trait, which was 192.0

cm<sup>2</sup>. While the overlap between the variety Iqmar and the Water hyacinth gave the highest average leaf area of 223.7 cm<sup>2</sup>. While the differences between them in the spring season, and there were no significant differences between them in the fall season. The bilateral interaction between silverleaf and the concentration of 0 mg L<sup>-1</sup> gave the highest average leaf area of 250.3 cm<sup>2</sup>. While silverleaf and the concentration of 5 mg L<sup>-1</sup> gave the lowest mean for the trait, which was 181.4 cm<sup>2</sup>. While the Water hyacinth and the concentration of 5 mg L<sup>-1</sup> gave the highest average of leaf area, which was 223.1 cm<sup>2</sup>. While the Water hyacinth gave at the spray level 25 mg L<sup>-1</sup> the lowest average for the trait was 175.5 cm<sup>2</sup>. The results of the bilateral interaction between the cultivars and the concentration showed that there were significant differences between them in the spring and fall seasons. As the cultivar gave Iqmar when compared to (0 mg L<sup>-1</sup>), the highest average leaf area was 248.6 cm<sup>2</sup>. cultivar Sakha and Water hyacinth gave the lowest average leaf area of 179.9 cm<sup>2</sup>. It was found through the results of the bilateral overlap between species and concentrations that there were significant While the variety gave Sakha at the spray level of 25 mg L<sup>-1</sup>, the lowest average for the trait was 160.0 cm<sup>2</sup> for the spring season, and in the fall season the variety gave Sakha and the concentration of 25 mg L<sup>-1</sup> the highest average for the leaf area was 365.5 cm<sup>2</sup>.

Table 2. Effect of spraying with plant extract of Water hyacinth and silverleaf herbs on leaf area (cm<sup>2</sup>) for sunflower.

cultivars	weeds	Spring 2020 concentration mg L <sup>-1</sup>				mean	Fall 2020 concentration mg L <sup>-1</sup>				mean
		0	5	15	25		0	5	15	25	
Ishaqi	Silverleaf	219.8	170.1	190.2	278.7	205.6	248.5	265.1	229.9	231.7	254.4
	Water hyacinth	177.8	202.2	238.8	166.9		265.3	240.3	282.4	272.1	
Iqmar	Silverleaf	257.4	159.4	204.3	146.7	207.8	293.5	210.6	271.8	266.6	249.3
	Water hyacinth	239.9	196.0	226.6	232.4		266.8	235.1	290.4	159.4	
Sakha	Silverleaf	273.6	214.8	258.4	192.7	207.4	352.8	218.4	293.4	371.4	307.4
	Water hyacinth	185.9	271.1	135.1	127.3		331.7	283.4	248.2	359.7	
P≤ 0.05		39.48				N.S	56.07				16.83
cultivars	Ishaqi	198.8	186.1	214.5	222.8		256.9	252.7	256.2	251.9	
	Iqmar	248.6	177.7	215.4	189.6		280.2	222.8	281.1	213.0	
	Sakha	229.8	243.0	196.8	160.0		342.2	250.9	270.8	365.5	
P≤ 0.05		20.14					38.88				
weeds	Silverleaf	250.3	181.4	217.6	206.0		298.3	231.4	265.0	289.9	
	Water hyacinth	201.2	223.1	200.2	175.5		288.0	252.9	273.6	263.7	
P≤ 0.05		22.79					N.S				
mean		225.7	202.3	208.9	190.8		293.1	242.1	269.3	276.8	
P≤ 0.05		12.14					24.78				
cultivars		weeds					weeds				
		Silverleaf		Water hyacinth			Silverleaf		Water hyacinth		
	Ishaqi	214.7		196.4			243.8		265.0		
	Iqmar	192.0		223.7			260.6		237.9		
	Sakha	234.9		179.9			309.0		305.7		
P≤ 0.05		19.74					N.S				
mean		213.9		200.0			271.1		269.6		
P≤ 0.05		11.40					N.S				

While the bilateral overlap between the cultivar Iqmar and the concentration of 25 mg L<sup>-1</sup> gave the lowest mean of the trait of 213.0 cm<sup>2</sup>. As for the triple overlap between varieties, species and concentrations, the results indicated that there are significant differences between them in the spring and fall seasons. As the cultivar Ishaqi and silverleaf at a concentration of 25 mg L<sup>-1</sup> gave the highest average leaf area of 278.7 cm<sup>2</sup>. While the cultivar gave Sakha and Water hyacinth and the concentration of 25 mg L<sup>-1</sup>, the lowest average for the trait was 127.3 cm<sup>2</sup>. In the fall season, the triple overlap between the cultivar Sakha and silverleaf and the concentration of 25 mg L<sup>-1</sup> gave the highest average leaf area of 371.4 cm<sup>2</sup>. While the cultivar gave Iqmar and water hyacinth and the concentration of 25 mg L<sup>-1</sup> the lowest average for the trait was 159.4 cm<sup>2</sup>. As for the extracts, the Water hyacinth outperformed the plant height in both seasons and the stem diameter in the spring season (Table 1 and 3), while the silverleaf herb extract outperformed the leaf area in both seasons and the stem diameter in the fall season (Tables 2 and 3). It is attributed to the different compounds content of the two herbs, which affects their allelopathic ability. This may be attributed to the difference in the components of the active substances in the two types according to the genetic difference and the two varieties, being from two different families, which caused the production of certain compounds for each of them that may be inhibitory and in the other stimulating. It affected cell division and expansion and decreased chlorophyll content [18]. It contains active compounds such as alkaloids, flavonoids, and tannins [32]. It may also be attributed to the difference and nature of the genetic material of the varieties in response to a certain level of growth and stress inputs, including allelopathic stress resulting from different concentrations of plant extracts [33]. This is in line with what was stated by [34] who showed that plant species differ in their content of allelopathic compounds, as these species contribute to the elective and that the low concentration of 1.75 mM of L-tryptophan is the inhibitory concentration of root growth in wheat.

### 3.3. Stem diameter (mm)

The results of Table (3) showed the effect of spraying with the plant extract of the two herbs of Water hyacinth and silverleaf in the stem diameter (mm) of the sun flower, there were no significant differences between the varieties in the spring and fall seasons. As for the species, the results show that there are significant differences between them in the spring and fall seasons, as the Water hyacinth gave the highest average stem diameter of 20.45 mm in the spring season. While silverleaf gave the lowest mean stem diameter of 18.65 mm. In the fall season, silverleaf gave the highest average stem diameter of 20.86 mm. While the Water hyacinth gave the lowest average stem diameter of 19.65 mm. The results also show that there are significant differences between spray concentrations in the spring and fall seasons. The comparison treatment in the spring and fall seasons gave the highest average stem diameter of 21.07 and 21.58 mm for the two seasons respectively. While the concentration gave a concentration of 25 mg liter-1 the lowest average stem diameter in the spring and fall seasons, which was 17.97 and 19.14 mm for the two seasons respectively. And it was found through the results of the bilateral overlap between the varieties and species that there were no significant differences between them in the spring season, while there were differences between them in the fall season. The variety Ishaqi and silverleaf gave the highest mean stem diameter of 21.14 mm. While the variety Sakha and silverleaf gave the lowest average stem diameter of 20.38 mm. While the variety Sakha, along with the Water hyacinth, gave the highest average stem diameter of 20.53 mm. While the variety Ishaqi and Water hyacinth gave the lowest mean stem diameter of 19.08 mm. The bilateral overlap between species and concentrations shows significant differences between them in the spring and fall seasons. Silverleaf and the comparison treatment (0 mg L<sup>-1</sup>) gave the highest mean stem diameter in the spring and fall seasons, which was 20.85 and 23.38 mm for the two seasons respectively. While silverleaf and concentration were given 25 mg L<sup>-1</sup> in the spring season, the average minimum stem diameter was 16.50 mm. While silverleaf and concentration 15 mg L<sup>-1</sup> in the fall season gave the lowest average stem diameter of 19.59 mm. While Water hyacinth and concentration 0 mg L<sup>-1</sup> in the spring season gave the highest average stem diameter of 21.29 mm. While Water hyacinth gave the concentration of 15 mg L<sup>-1</sup> the lowest average for the trait was 19.92 mm. In the fall



season, the Water hyacinth and the concentration 15 mg L<sup>-1</sup> gave the highest average stem diameter of 20.37 mm. While Water hyacinth and concentration gave 25 mg L<sup>-1</sup> the lowest mean stem diameter was 18.44 mm. The results of the bilateral overlap between the cultivars and the concentrations indicated that there were significant differences between them in the spring and fall seasons. The double overlap between the cultivar and the Iqmar and the comparison treatment gave the highest average stem diameter of 23.13 mm. While the bilateral interaction between the cultivar Sakha and the concentration of 15 mg L<sup>-1</sup> gave the lowest average stem diameter of 17.63 mm, which did not differ significantly from the interaction between the cultivar Iqmar and Ishaqi and the concentration of 25 mg L<sup>-1</sup>, which gave 17.70 and 17.82 mm for the two varieties respectively. In the fall season, the cultivar gave Ishaqi and the spray concentration was 0 mg L<sup>-1</sup>, the highest average stem diameter was 22.42 mm.

Table 3. Effect of spraying with plant extract of Water hyacinth and silverleaf herbs on stem diameter (mm) for sunflower.

cultivars	weeds	Spring 2020 concentration mg L <sup>-1</sup>				mean	Fall 2020 concentration mg L <sup>-1</sup>				mean
		0	5	15	25		0	5	15	25	
Ishaqi	Silverleaf	18.40	20.14	19.55	16.18	19.23	24.83	22.23	19.17	18.33	20.11
	Water hyacinth	19.11	19.73	20.99	19.46		20.00	20.00	20.67	15.67	
Iqmar	Silverleaf	22.83	18.16	20.27	15.18	20.25	21.97	21.00	19.27	22.00	20.20
	Water hyacinth	23.43	20.89	21.02	20.22		18.67	19.67	19.33	19.67	
Sakha	Silverleaf	21.31	15.90	17.52	18.13	19.18	23.33	18.67	20.33	19.20	20.46
	Water hyacinth	21.34	22.83	17.74	18.66		20.67	20.33	21.11	20.00	
P ≤ 0.05		2.63				N.S	N.S				N.S
cultivars	Ishaqi	18.75	20.07	20.27	17.82		22.42	21.12	19.92	17.00	
	Iqmar	23.13	19.53	20.65	17.70		20.32	20.33	19.30	20.83	
	Sakha	21.33	19.37	17.63	18.40		22.00	19.50	20.72	19.60	
P ≤ 0.05		2.04					1.48				
weeds	Silverleaf	20.85	18.16	19.11	16.50		23.38	20.63	19.59	19.84	
	Water hyacinth	21.29	21.15	19.92	19.45		19.78	20.00	20.37	18.44	
P ≤ 0.05		1.37					1.22				
mean		21.07	19.65	19.52	17.97		21.58	20.32	19.98	19.14	
P ≤ 0.05		1.22					0.89				
cultivars	Ishaqi	weeds					weeds				
		Silverleaf	18.63	19.82		Silverleaf	21.14	19.08			
	Iqmar	weeds					weeds				
		Silverleaf	19.11	21.39		Silverleaf	21.06	19.33			
Sakha	weeds					weeds					
P ≤ 0.05		N.S					1.06				
mean		18.65	20.45			20.86	19.65				
P ≤ 0.05		0.69					0.63				

While the cultivar gave a flatulence and concentration of 25 mg L<sup>-1</sup>, the lowest mean stem diameter was 17.00 mm. The results of the triple overlap between varieties, types and concentrations indicated that there were differences between them in the spring season and that there were no differences between them in the fall season. The triple overlap between the cultivar Iqmar and the Water hyacinth

and the concentration 0 mg L<sup>-1</sup> gave the highest average stem diameter of 23.43 mm. While the cultivar gave Iqmar and silverleaf, the concentration was 25 mg L<sup>-1</sup>, the lowest mean of the stem diameter was 15.18 mm, which did not differ significantly from the triple overlap between the cultivar Sakha and silverleaf, and the concentration was 5 mg L<sup>-1</sup>, which gave 15.90 mm.

### 3.4. Dry weight of weeds at harvest (g m<sup>2</sup>)

The results of Table (4) indicated the effect of spraying with plant extracts of Water hyacinth and silverleaf on the dry weight of the weeds at harvest (g m<sup>2</sup>) of sun flower, indicating that there were no significant differences between varieties in the spring and fall seasons. The results also showed that there are differences between species in the spring and fall seasons, as the Water hyacinth outperformed in both seasons by giving it the highest average dry weight of the weeds at harvest, which was 0.045 and 0.053 g m<sup>2</sup> for the two seasons respectively. While silverleaf gave the lowest average dry weight of the weeds when harvested in the spring and fall seasons, which was 0.032 and 0.043 g m<sup>2</sup>. It was found through the results in the same table that there were significant differences between the spray concentrations.

Table 4. Effect of spraying with plant extract of Water hyacinth and silverleaf herbs on Dry weight of weeds at harvest (g m<sup>2</sup>) for sunflower.

cultivars	weeds	Spring 2020				mean	Fall 2020				mean
		concentration mg L <sup>-1</sup>					concentration mg L <sup>-1</sup>				
		0	5	15	25		0	5	15	25	
Ishaqi	Silverleaf	0.00	0.067	0.050	0.040	0.045	0.000	0.068	0.059	0.062	0.048
	Water hyacinth	0.03	0.067	0.043	0.063		0.059	0.035	0.037	0.064	
Iqmar	Silverleaf	0.00	0.033	0.030	0.057	0.033	0.000	0.041	0.047	0.072	0.051
	Water hyacinth	0.02	0.027	0.047	0.047		0.053	0.059	0.046	0.087	
Sakha	Silverleaf	0.00	0.047	0.027	0.030	0.038	0.000	0.024	0.093	0.049	0.046
	Water hyacinth	0.06	0.053	0.020	0.060		0.056	0.042	0.046	0.053	
P ≤ 0.05		0.015				N.S	N.S				N.S
cultivars	Ishaqi	0.01	0.067	0.047	0.052		0.030	0.051	0.048	0.063	
	Iqmar	0.01	0.030	0.039	0.052		0.027	0.050	0.047	0.080	
	Sakha	0.03	0.050	0.023	0.045		0.028	0.033	0.070	0.051	
P ≤ 0.05		0.014					N.S				
weeds	Silverleaf	0.00	0.049	0.036	0.042		0.000	0.044	0.066	0.061	
	Water hyacinth	0.04	0.049	0.037	0.057		0.056	0.045	0.043	0.068	
P ≤ 0.05		0.011					0.019				
mean		0.02	0.049	0.036	0.049		0.028	0.045	0.055	0.065	
P ≤ 0.05		0.010					0.016				
cultivars		weeds					weeds				
	Ishaqi	Silverleaf	0.039	Water hyacinth	0.051		Silverleaf	0.047	Water hyacinth	0.049	
	Iqmar	0.030		0.036		0.040		0.061			
Sakha	0.026		0.049		0.042		0.050				
P ≤ 0.05		0.010					N.S				
mean		0.032		0.045		0.043		0.053			
P ≤ 0.05		0.004					0.009				

The concentration of 25 mg L<sup>-1</sup> in the spring and fall seasons gave the highest average dry weight of the weeds at harvest, which was 0.049 and 0.065 g m<sup>2</sup> for the two seasons respectively, which did not differ from the concentration of 5 mg L<sup>-1</sup> in the spring season, which gave 0.049 g m<sup>2</sup>. While the comparison treatment in the spring and fall seasons gave the lowest mean for the trait, which was 0.020 and 0.028 g m<sup>2</sup> for the two seasons respectively. The results of the bilateral overlap between the varieties and species indicated that there were significant differences between them in the spring season, while there were no significant differences between them in the fall season. The double overlap between Ishaqi cultivar, silverleaf and Water hyacinth gave the highest average dry weight of the hind weeds of harvest, which was 0.039 and 0.051 g m<sup>2</sup> for the two interactions, respectively. While Sakha, silverleaf, Iqmar and Water hyacinth gave the lowest average dry weight of the weeds at harvest, which was 0.026 and 0.036 g m<sup>2</sup> for the two interactions respectively. It was noticed through the bilateral overlap between the concentrations and species that there were significant differences between them in the spring and fall season. The silverleaf and the concentration of 5 mg L<sup>-1</sup> in the spring season gave the highest average dry weight of the weeds at harvest, which was 0.049 g m<sup>2</sup>. While silverleaf and concentration 15 mg L<sup>-1</sup> gave the lowest mean for the trait, it was 0.036 g m<sup>2</sup>. While the Water hyacinth and the concentration of 25 mg L<sup>-1</sup> gave the highest average dry weight of the weeds at harvest, which was 0.057 g m<sup>2</sup>. While Water hyacinth gave the concentration of 15 mg L<sup>-1</sup> the lowest average for the trait, it was 0.037 g m<sup>2</sup>. In the fall season, silverleaf at concentration 15 mg L<sup>-1</sup> gave the highest average dry weight of the weeds at harvest, which was 0.066 g m<sup>2</sup>. While silverleaf and concentration 5 mg L<sup>-1</sup> gave the lowest mean for the trait, it was 0.044 g m<sup>2</sup>. While the Water hyacinth and the concentration of 25 mg L<sup>-1</sup> gave the highest average dry weight of the weeds at harvest, which was 0.068 g m<sup>2</sup>. While the Water hyacinth and the concentration 15 mg L<sup>-1</sup> gave the lowest mean for the trait, it was 0.043 g m<sup>2</sup>. The results of the two-way overlap between the varieties and the concentrations showed that there were significant differences between them in the spring season, and there were no differences between them in the fall season. The variety, squash and concentration of 5 mg L<sup>-1</sup>, gave the highest average dry weight of the weeds at harvest, which was 0.067 g m<sup>2</sup>. While the overlap between the variety Iqmar and the concentration (0 mg L<sup>-1</sup>) gave the lowest mean for the trait, it was 0.013 g m<sup>2</sup>. It was found through the results of the triple overlap between varieties, species and concentration that there were significant differences between them in the spring season and that there were no significant differences between them in the fall season. The triple interaction between the Ishaqi variety and the silverleaf and the concentration of 5 mg L<sup>-1</sup> gave the highest average dry weight of the weeds at harvest was 0.067 g m<sup>2</sup>, hyacinth and the concentration is 5 mg L<sup>-1</sup>, which was 0.067 g m<sup>2</sup>. While the triple interaction between the cultivar Sakha and the Water hyacinth and the concentration of 15 mg L<sup>-1</sup> gave the lowest average which did not differ significantly from the triple interaction between the variety Ishaqi and Water for the trait, it was 0.020 g m<sup>2</sup>.

### 3.5. Disk Diameter (cm)

The results of Table (5) showed the effect of spraying with plant extracts of the Water hyacinth and silverleaf herbs in the stem diameter (cm) of the sun flower, to the absence of significant differences between the varieties and species in the spring and fall seasons. It was found from the results of the same seasons. In the spring season, the concentration of 0 mg L<sup>-1</sup> gave the highest mean disc<sup>-1</sup> diameter of 23.59 cm. While the highest concentration was 5 mg L<sup>-1</sup>, the lowest average for the disc<sup>-1</sup> diameter was table that there were significant differences between the concentrations of spraying in the spring and fall 21.20 cm. In the fall season, the concentration was 15 mg L<sup>-1</sup>, the highest average diameter of the disc<sup>-1</sup> was 22.39 cm. While the comparison treatment (0 mg L<sup>-1</sup>) gave the lowest mean disc<sup>-1</sup> diameter of 19.84 cm. The results of the bilateral overlap between the varieties and species indicated that there were significant differences between them in the spring season only. While there were no differences between them in the fall season. The bilateral overlap between the variety Iqmar and the silverleaf gave the highest mean disc diameter of 23.75 cm. While the overlap between the variety Ishaqi and silverleaf gave the lowest mean for the trait, which was 21.36 cm.

Table 5. Effect of spraying with plant extracts of Water hyacinth and silverleaf on disc diameter (cm) of sunflower.

cultivars	weeds	Spring 2020 concentration mg L <sup>-1</sup>				mean	Fall 2020 concentration mg L <sup>-1</sup>				mean	
		0	5	15	25		0	5	15	25		
Ishaqi	Silverleaf	22.66	23.11	21.44	18.22	22.22	24.19	23.87	19.45	19.40	21.49	
	Water hyacinth	25.33	19.67	23.00	24.33		21.88	19.15	22.55	21.45		
Iqmar	Silverleaf	25.32	21.00	25.55	23.11	23.21	16.27	22.59	21.00	20.40	19.73	
	Water hyacinth	23.25	20.00	23.44	24.00		20.11	21.13	18.24	18.11		
Sakha	Silverleaf	22.67	22.00	21.33	20.00	21.30	18.59	21.49	26.53	21.29	21.65	
	Water hyacinth	22.33	21.44	19.00	21.66		18.00	20.48	26.57	20.23		
P≤ 0.05		2.46				N.S	2.72				N.S	
cultivars	Ishaqi	24.00	21.39	22.22	21.28		23.04	21.51	21.00	20.42		
	Iqmar	24.29	20.50	24.50	23.55		18.19	21.86	19.62	19.26		
	Sakha	22.50	21.72	20.17	20.83		18.29	20.98	26.55	20.76		
P≤ 0.05		1.35					2.33					
weeds	Silverleaf	23.55	22.04	22.78	20.44		19.68	22.65	22.32	20.36		
	Water hyacinth	23.64	20.37	21.81	23.33		20.00	20.25	22.46	19.93		
P≤ 0.05		1.42					1.40					
mean		23.59	21.20	22.29	21.89		19.84	21.45	22.39	20.15		
P≤ 0.05		0.78					1.12					
cultivars	weeds		Silverleaf	Water hyacinth			weeds		Silverleaf	Water hyacinth		
	Ishaqi		21.36	23.08			21.72	21.26				
	Iqmar		23.75	22.67			20.06	19.40				
	Sakha		21.50	21.11			21.97	21.32				
P≤ 0.05		1.23					N.S					
mean		22.20	22.29			21.25	20.66					
P≤ 0.05		N.S					N.S					

Whereas, the bilateral interaction between the cultivar Ishaqi and the Water hyacinth gave the highest average disc diameter of 23.08 cm. While the variety Sakha and Water hyacinth gave the lowest average disc diameter of 21.11 cm. The results of the bilateral overlap between species and concentrations showed that there were significant differences between them in the spring and fall seasons. The two-way interaction between silverleaf and the comparison treatment in the spring season gave the highest average disc diameter of 23.55 cm. Whereas, silverleaf, at concentration of 25 mg L<sup>-1</sup>, gave the lowest mean disc<sup>-1</sup> diameter of 20.44 cm. While the Water hyacinth and the comparison treatment gave the highest average disk diameter of 23.64 cm. While Water hyacinth and the concentration of 5 mg L<sup>-1</sup> gave the lowest average disc<sup>-1</sup> diameter of 20.37 cm. In the fall season, he gave a double overlap between silverleaf and concentrate 5 mg L<sup>-1</sup>, the highest mean disc<sup>-1</sup> diameter was 22.65 cm, which was not significantly different from the interaction between silverleaf and the concentration of 15 mg L<sup>-1</sup>, which was 22.32 cm. While silverleaf, when compared, gave the lowest mean disc diameter of 19.68 cm. While Water hyacinth and concentration 15 mg L<sup>-1</sup> gave the highest average disc<sup>-1</sup> diameter of 22.46 cm. While Water hyacinth gave the concentration of 25 mg L<sup>-1</sup> the

lowest average for the disc<sup>-1</sup> diameter of 19.93 cm. It is noticed from the results of the bilateral overlap between the cultivar and the concentrations that there are significant differences between them in the spring and fall seasons. The double overlap between the Iqmar cultivar and the concentration of 15 mg L<sup>-1</sup> gave the highest average disk diameter of 24.50 cm, which did not differ significantly from the interference between the Iqmar cultivar and the comparison treatment, which reached 24.29 cm. While the bilateral interaction between the cultivar Sakha and the concentration of 15 mg L<sup>-1</sup> gave the lowest average for the disc diameter of 20.17 cm. In the fall season, the cultivar gave Sakha at a spraying level of 15 mg L<sup>-1</sup>. The highest average disc diameter was 26.55 cm. While the overlap between the Iqmar variety and the variety Sakha when the comparison was (0 mg L<sup>-1</sup>), the lowest average disk diameter was 18.19 and 18.29 cm for the two interactions respectively. The results of the triple overlap between varieties, species and concentrations showed that there were significant differences between them in the spring and fall season. The triple overlap between the Iqmar variety and silverleaf and the concentration of 15 mg L<sup>-1</sup> in the spring season gave the highest average disc diameter of 25.55 cm. While the triple interaction between Ishaqi cultivar and silverleaf at concentration of 25 mg L<sup>-1</sup> gave the lowest average disc<sup>-1</sup> diameter of 18.22 cm. In the fall season, the triple overlap between the cultivar Sakha and the Water hyacinth and the concentration 15 mg L<sup>-1</sup> gave the highest average disc diameter of 26.57 cm, which did not differ significantly from the interaction between the cultivar Sakha and silverleaf, and the concentration was 15 mg L<sup>-1</sup>, which reached 26.53 cm. Whereas, the triple interference between the cultivar Iqmar and silverleaf when compared with (0 mg L<sup>-1</sup>) gave the lowest mean disc diameter of 16.27 cm.

### 3.6. Number of seeds per disc (seed disc<sup>-1</sup>)

The results of Table (6) showed the effect of spraying with the plant extract of the Water hyacinth and silverleaf herbs on the number of seeds per disc (seed per disc<sup>-1</sup>) of the sunflower, to the absence of significant differences between the varieties and species in the spring and fall seasons. The same table found significant differences between spray concentrations in the spring and fall seasons. As the concentration of 0 mg L<sup>-1</sup> in the spring season gave the highest average number of seeds per disc, which reached 1473 seeds per disc<sup>-1</sup>. While the concentration of 25 mg L<sup>-1</sup> gave the lowest average number of seeds per disc<sup>-1</sup>, which was 1234 seeds per disc<sup>-1</sup>. In the fall season, the concentration of 15 mg L<sup>-1</sup> gave the highest mean number of seeds per disc<sup>-1</sup>, which was 924 seeds of disc<sup>-1</sup>, which was not significantly different from the comparison treatment which gave 922 seeds per disc<sup>-1</sup>. While the concentration of 25 mg L<sup>-1</sup> gave the lowest average number of seeds per disc<sup>-1</sup>, which was 833 seeds per disc<sup>-1</sup>. It is noted from the results of the bilateral overlap between the varieties and species that there are significant differences between them in the spring season, while there were no differences between them in the fall season. The double overlap between the variety Ishaqi, the silverleaf and the Water hyacinth gave the highest average number of seeds per disc<sup>-1</sup> of 1414 and 1434 seeds per disc<sup>-1</sup> for the two interactions respectively. Whereas, the double overlap between the variety Sakha and silverleaf gave the lowest average number of seeds per disc<sup>-1</sup> with 1253 seeds per disc<sup>-1</sup>. While the overlap between the variety Iqmar and the Water hyacinth gave the lowest average number of fallow trees per disc<sup>-1</sup>, which amounted to 1196 disc<sup>-1</sup> seeds. The results of the bilateral overlap between species and concentrations showed that there were significant differences between them in the spring and fall seasons. The silverleaf at a concentration of 0 mg L<sup>-1</sup> in the spring season gave the highest average number of seeds per disc<sup>-1</sup>, which reached 1559 seeds per disc<sup>-1</sup>. Whereas, the bilateral interaction between silverleaf and the concentration of 25 mg L<sup>-1</sup> gave the lowest average number of seeds per disc<sup>-1</sup> which was 1107 seeds of disc<sup>-1</sup>. While the Water hyacinth and the concentration 0 mg L<sup>-1</sup> gave the highest average number of seeds per disc<sup>-1</sup>, reaching 1387 seeds per disc<sup>-1</sup>. While the bilateral interaction between the Water hyacinth and the concentration of 5 mg L<sup>-1</sup> gave the lowest average number of seeds per disc<sup>-1</sup> 1260 seed per disc<sup>-1</sup>. In the fall season, the interaction between silverleaf and the concentration of 5 mg L<sup>-1</sup> gave the highest average number of seeds per disc<sup>-1</sup> of 963 seeds of disc<sup>-1</sup>. While the interaction between silverleaf and the concentration of 25 mg L<sup>-1</sup> gave the lowest average number of seeds per disc<sup>-1</sup> of 836 seeds of disc<sup>-1</sup>. While the Water hyacinth at the spray

level of 15 mg L<sup>-1</sup> gave the highest average number of seeds per disc<sup>-1</sup>, which reached 953 seeds per disc<sup>-1</sup>. While the bilateral interaction between the Water hyacinth and the concentration of 25 mg L<sup>-1</sup> gave the lowest average number of seeds per disc<sup>-1</sup>, which was 830 seeds of disc<sup>-1</sup>.

Table 6. The effect of spraying with plant extracts of the Water hyacinth and silverleaf herbs on the number of seeds per disc (seeds per disc<sup>-1</sup>) of sunflower.

cultivars	weeds	Spring 2020 concentration mg L <sup>-1</sup>				mean	Fall 2020 concentration mg L <sup>-1</sup>				mean
		0	5	15	25		0	5	15	25	
Ishaqi	Silverleaf	1773	1576	1149	1159	1424	878	1070	958	925	917
	Water hyacinth	1428	1266	1456	1588		814	805	1035	848	
Iqmar	Silverleaf	1512	1274	1210	1085	1233	838	1078	893	727	895
	Water hyacinth	1039	1101	1387	1257		1024	861	931	806	
Sakha	Silverleaf	1391	1229	1315	1076	1325	1163	742	836	854	874
	Water hyacinth	1695	1414	1241	1240		815	850	894	836	
P≤ 0.05		249.4				N.S	142.1				N.S
cultivars	Ishaqi	1600	1421	1302	1373		846	938	996	886	
	Iqmar	1275	1188	1298	1171		931	970	912	767	
	Sakha	1543	1322	1278	1158		989	796	865	845	
P≤ 0.05		N.S					102.9				
weeds	Silverleaf	1559	1360	1225	1107		960	963	895	836	
	Water hyacinth	1387	1260	1361	1362		884	839	953	830	
P≤ 0.05		144.0					82.1				
mean		1473	1310	1293	1234		922	901	924	833	
P≤ 0.05		94.5					59.8				
cultivars		weeds		weeds			weeds		weeds		
		Silverleaf	Water hyacinth	Silverleaf	Water hyacinth		Silverleaf	Water hyacinth	Silverleaf	Water hyacinth	
	Ishaqi	1414	1434	958	875		958	875	958	875	
	Iqmar	1270	1196	884	906		884	906	884	906	
Sakha	1253	1398	899	849		899	849	899	849		
P≤ 0.05		124.7					N.S				
mean		1312	1343	914	877		914	877	914	877	
P≤ 0.05		N.S					N.S				

The results of the bilateral overlap between the varieties and the concentrations showed that there were no significant differences between them in the spring season, while there were significant differences between them in the fall season. The two-way interaction between the Ishaqi cultivar and the concentration of 15 mg L<sup>-1</sup> gave the highest average number of seeds per disc<sup>-1</sup>, reaching 996 seeds per disc<sup>-1</sup>. Whereas, the bilateral interaction between the cultivar is Ishaqi when the comparison treatment (0 mg L<sup>-1</sup>) gave the lowest average number of seeds per disc<sup>-1</sup>, which amounted to 846 seeds of disc<sup>-1</sup>. The results of the triple overlap between varieties, species and concentrations indicated that there were significant differences between them in the spring and fall seasons. The triple overlap in the spring season between the Ishaqi variety and the silverleaf when the comparison treatment (0 mg L<sup>-1</sup>) gave the highest average number of seeds per disc<sup>-1</sup> which reached 1773 seeds of disc<sup>-1</sup>. While the interaction between the variety Iqmar and the Water hyacinth and the concentration 0 mg L<sup>-1</sup> gave the lowest average number of seeds per disc<sup>-1</sup> which was 1039 seeds of the disc<sup>-1</sup>. In the fall season, the triple overlap between the cultivar Sakha and silverleaf and the comparison treatment (0 mg L<sup>-1</sup>) gave the highest average number of seeds per disc<sup>-1</sup> with 1163 seeds per disc<sup>-1</sup>. Whereas, the triple overlap between Iqmar and silverleaf and a concentration of 25 mg L<sup>-1</sup> gave the lowest average number of seeds per disc<sup>-1</sup> which was 727 seeds per disc<sup>-1</sup>.

### 3.7. Weight of 1000 seeds (g)

The results of Table (7) indicated the effect of spraying with the plant extract of the Water hyacinth and silverleaf herbs in the weight of 1000 seeds (g) for the sunflower, indicating that there were no significant differences between the varieties in the weight of 1000 seeds in both the spring and fall seasons. Also, significant differences were found between species in the weight of 1000 seeds in both seasons. In the spring and fall seasons, silverleaf gave the highest average weight of 1000 seeds, which reached 59.25 and 67.20 g for the two seasons, respectively. While the Water hyacinth gave in the spring and fall seasons the lowest average weight of 1000 seeds, which was 54.62 and 61.68 g for the two seasons respectively. It was observed from the results of the same table that there were significant differences between spray concentrations in the spring and fall seasons. The concentration of 5 mg L<sup>-1</sup> in both the spring and fall seasons gave the highest average weight of 1000 seeds, which reached 59.57 and 67.94 g for the two seasons respectively, which did not differ significantly from the concentration of 15 mg L<sup>-1</sup> in the spring season, which gave 59.59 g. While the comparison treatment in the spring and fall seasons gave the lowest average for the weight of 1000 seeds, amounting to 53.91 and 61.88 g for the two seasons respectively. The results of the bilateral overlap between the varieties and species indicated that there were no significant differences between them in the spring season, but there were significant differences between them in the fall season.

Table 7. Effect of spraying with plant extracts of Water hyacinth and silverleaf on the weight of 1000 seeds (g) of sunflower.

cultivars	weeds	Spring 2020 concentration mg L <sup>-1</sup>				mean	Fall 2020 concentration mg L <sup>-1</sup>				mean
		0	5	15	25		0	5	15	25	
Ishaqi	Silverleaf	65.61	53.93	66.21	65.51	60.39	68.29	64.81	79.37	71.22	65.75
	Water hyacinth	54.02	56.90	72.08	48.89		54.03	69.74	71.83	46.75	
Iqmar	Silverleaf	52.41	58.49	65.50	54.84	54.28	61.20	60.39	56.37	75.99	62.33
	Water hyacinth	53.08	44.49	54.41	51.00		58.54	63.66	56.44	66.01	
Sakha	Silverleaf	44.71	76.64	49.26	57.93	56.13	71.49	72.92	63.48	60.89	65.24
	Water hyacinth	53.61	66.98	50.07	49.83		57.73	76.12	53.81	65.46	
P<0.05		11.20				N.S	7.08				N.S
cultivars	Ishaqi	59.82	55.42	69.14	57.20		61.16	67.27	75.60	58.98	
	Iqmar	52.75	51.49	59.95	52.92		59.87	62.03	56.41	71.00	
	Sakha	49.16	71.81	49.67	53.88		64.61	74.52	58.64	63.17	
P<0.05		8.77					5.10				
weeds	Silverleaf	54.24	63.02	60.32	59.43		67.00	66.04	66.41	69.36	
	Water hyacinth	53.57	56.13	58.85	49.91		56.77	69.84	60.69	59.41	
P<0.05		N.S					4.17				
mean		53.91	59.57	59.59	54.67		61.89	67.94	63.55	64.39	
P<0.05		5.06					3.08				
cultivars		weeds		weeds			weeds		weeds		
	Ishaqi	Silverleaf	62.82	Water hyacinth	57.97		Silverleaf	70.92	Water hyacinth	60.59	
	Iqmar	57.81		50.75		63.49		61.17			
	Sakha	57.13		55.12		64.19		63.28			
P<0.05		N.S					3.53				
mean		59.25		54.62		67.20		61.68			
P<0.05		3.23					2.12				

The Ishaqi variety and silverleaf gave the highest average weight of 1000 seeds, which was 70.92 g. Whereas, the two-way interaction between Iqmar and silverleaf gave the lowest average weight of 1000 seeds, 63.49 g. Whereas, the bilateral interaction between Sakha and Water hyacinth gave the

highest average weight of 1000 seeds, which was 63.28 g. While the variety Ishaqi and Water hyacinth gave the lowest average weight of 1000 seeds, which was 60.59 g. The results of the bilateral overlap between concentrations and species showed that there were no significant differences between them in the spring season, while there were significant differences between them in the fall season. The silverleaf and the concentration of 25 mg L<sup>-1</sup> gave the highest average weight of 1000 seeds, which was 69.36 g. While the bilateral interaction between silverleaf and the concentration of 5 mg L<sup>-1</sup> gave the lowest mean for the weight of 1000 seeds, which was 66.04 g. Whereas, the bilateral interaction between the Water hyacinth and the concentration of 5 mg L<sup>-1</sup> gave the highest average weight of 1000 seeds, which was 69.84 g. While the Water hyacinth and the comparison treatment (0 mg L<sup>-1</sup>) gave the lowest average weight of 1000 seeds, which was 56.77 g. It was also found from the results of the bilateral overlap between the cultivars and the concentrations that there were significant differences between them in the spring and fall seasons. The double overlap between the Ishaqi cultivar and the spray level of 15 mg L<sup>-1</sup> in the spring and fall seasons gave the highest average weight of 1000 seeds which reached 69.14 and 75.60 g for the two seasons respectively. While the interaction between the cultivar Sakha and the concentration of 0 mg L<sup>-1</sup> in the spring season gave the lowest mean for the trait, which was 49.16 g, which did not differ significantly from the interaction between the cultivar Ishaqi and the concentration of 15 mg L<sup>-1</sup>, which reached 49.67 g. While the overlap between the Iqmar variety and the concentration of 15 mg L<sup>-1</sup> in the fall season gave the lowest average for the weight of 1000 seeds, which was 56.41 g. The results of the triple overlap between varieties, species and concentrations showed that there were significant differences between them in the spring and fall seasons. The triple overlap between Sakha and silverleaf and the concentration of 5 mg L<sup>-1</sup> in the spring season gave the highest average weight of 1000 seeds, which reached 76.64 g. While the triple overlap between the cultivar Sakha and silverleaf and the comparison treatment (0 mg L<sup>-1</sup>) gave the lowest average weight of 1000 seeds, which was 44.71 g. In the fall season, the triple overlap between the variety Ishaqi and silverleaf and the concentration 15 mg L<sup>-1</sup> gave the highest average weight of 1000 seeds, which was 79.37 g. While the triple interaction between the cultivar Sakha and the Water hyacinth and the concentration of 15 mg L<sup>-1</sup> gave the lowest average for the weight of 1000 seeds, which was 53.81 g.

### 3.8. Total yield (ton ha<sup>-1</sup>)

It is noted from the results of Table (8) the effect of spraying with the plant extract of the Water hyacinth and silverleaf herbs on the total yield (ton ha<sup>-1</sup>) of the sun flower. To the absence of significant differences between the varieties and the bilateral overlap between the varieties and species in both the spring and fall seasons. The results of the same table found that there were no significant differences between species in the spring season, while they were significant in the fall season. As silverleaf gave the highest average for the total yield of ton ha<sup>-1</sup>, which was 3.26 ton ha<sup>-1</sup>. While the Water hyacinth gave the lowest average for the total yield, which was 2.95 ton ha<sup>-1</sup>. The results showed that there were significant differences between the spray concentration in the spring and fall seasons. As the concentration of 15 mg L<sup>-1</sup> in the spring season gave the highest average for the total yield, which reached 5.35 ton ha<sup>-1</sup>. While the concentration of 25 mg L<sup>-1</sup> gave the lowest mean for the characteristic, which was 3.71 ton ha<sup>-1</sup>. In the fall season, the comparison treatment (0 mg L<sup>-1</sup>) gave the highest average for the total yield, which amounted to 3.31 ton ha<sup>-1</sup>. While the concentration 15 mg L<sup>-1</sup> gave the lowest average for the total yield, which was 2.91 ton ha<sup>-1</sup>. The results of the double overlap between species and concentrations showed that there were no significant differences between them in the spring season, while there were significant differences between them in the fall season. As the two-way interaction between silverleaf when the comparison treatment (0 mg L<sup>-1</sup>) gave the highest average total yield of 3.65 ton ha<sup>-1</sup>. While the interaction between silverleaf and the concentration of 15 mg L<sup>-1</sup> gave the lowest average for the total yield, which was 2.98 ton ha<sup>-1</sup>. Whereas, the bilateral interaction between the Water hyacinth and the concentration of 5 mg L<sup>-1</sup> gave the highest average



total yield, which reached 3.03 ton ha<sup>-1</sup>. While the bilateral interaction between the Water hyacinth and the concentration of 15 mg L<sup>-1</sup> gave the lowest average for the total yield, which was 2.84 ton ha<sup>-1</sup>. As for the bilateral overlap between varieties and concentrations, the results showed that there were significant differences between them in the spring season, while there were no significant differences between them in the fall season. The bilateral interaction between the isometric cultivar and the concentration of 15 mg L<sup>-1</sup> gave the highest average total yield of 5.46 ton ha<sup>-1</sup>. While the bilateral interaction between the cultivar Sakha and the spray level of 15 mg L<sup>-1</sup> gave the lowest average for the total yield, which reached 3.14 ton ha<sup>-1</sup>. The results of the triple overlap between varieties, species and concentrations indicated that there were significant differences between them in the spring and fall seasons. The triple overlap between the Ishaqi cultivar and silverleaf and the concentration of 15 mg L<sup>-1</sup> in the spring season gave the highest average total yield of 5.51 ton ha<sup>-1</sup>. While the triple overlap between the variety Sakha and silverleaf and the concentration of 15 mg L<sup>-1</sup> gave the lowest average for the total yield, which was 2.82 ton ha<sup>-1</sup>.

Table 8. Effect of spraying with plant extracts of Water hyacinth and silverleaf on the total yield (ton ha<sup>-1</sup>) of sunflower.

cultivars	weeds	Spring 2020 concentration mg L <sup>-1</sup>				mean	Fall 2020 concentration mg L <sup>-1</sup>				mean
		0	5	15	25		0	5	15	25	
Ishaqi	Silverleaf	4.97	4.21	5.51	3.49	4.62	4.06	2.97	2.97	3.11	3.15
	Water hyacinth	5.13	4.04	5.41	4.20		2.61	3.18	3.10	3.17	
Iqmar	Silverleaf	3.72	4.00	4.95	3.41	3.76	3.31	4.09	2.69	2.73	3.06
	Water hyacinth	3.62	3.00	3.95	3.54		3.19	2.84	2.83	2.80	
Sakha	Silverleaf	3.38	4.39	2.82	4.56	3.86	3.57	2.93	3.29	3.34	3.11
	Water hyacinth	4.06	5.20	3.45	3.03		3.08	3.07	2.60	2.97	
P≤0.05		1.02				N.S	0.57				N.S
cultivars	Ishaqi	5.05	4.13	5.46	3.85		3.34	3.07	3.04	3.14	
	Iqmar	3.67	3.50	4.45	3.48		3.25	3.47	2.76	2.77	
	Sakha	3.72	4.79	3.14	3.79		3.33	3.00	2.94	3.16	
P≤0.05		0.77					N.S				
weeds	Silverleaf	4.02	4.20	4.43	3.82		3.65	3.33	2.98	3.06	
	Water hyacinth	4.27	4.08	4.27	3.59		2.96	3.03	2.84	2.98	
P≤0.05		N.S					0.34				
mean		4.15	4.14	4.35	3.71		3.31	3.18	2.91	3.02	
P≤0.05		0.44					0.27				
cultivars	weeds	Silverleaf	Water hyacinth				Silverleaf	Water hyacinth			
		Ishaqi	4.55	4.69			3.28	3.01			
	Iqmar	4.02	3.53			3.21	2.92				
	Sakha	3.79	3.93			3.28	2.93				
P≤0.05		N.S					N.S				
mean		4.12	4.05				3.26	2.95			
P≤0.05		N.S					0.16				

In the fall season, the triple overlap between the Iqmar cultivar and silverleaf and the concentration of 5 mg L<sup>-1</sup> gave the highest average total yield of 4.09 ton ha<sup>-1</sup>. While the triple interaction between the cultivar Sakha and the Water hyacinth and the concentration of 15 mg L<sup>-1</sup> gave the lowest average for the total yield of 2.60 ton ha<sup>-1</sup>, which did not differ significantly from the triple interaction between the cultivar Ishaqi and the Water hyacinth when the comparison was treated (0 mg L<sup>-1</sup>), which reached 2.61 ton ha<sup>-1</sup>. It is noticed from the above results that the Iqmar cultivar was superior in plant height

(Table 1) in the spring season and the Ishaqi variety (Table 1) in the fall season. Also, the variety surpasses Sakha in the leaf area (Table 2) in the fall season, The 15 mg L<sup>-1</sup> concentration also increased plant height and leaf area in the spring season and disc diameter in the fall season (Tables 1, 2 and 5). Whereas, the 25 mg L<sup>-1</sup> concentration increased plant height and leaf area in the fall season (Tables 1 and 2). This significant effect may be attributed to the difference in the concentrations of the active ingredients within the plant itself. Each plant type has a certain content of the active compounds that differ in the concentration and type of the active compound [35]. The concentration exceeded 5 mg L<sup>-1</sup> in stem diameter in both seasons (Table 3). The reason may be attributed to the low concentrations of the extract that may act as growth regulators, causing the stem cells to divide and elongate, which was reflected in the stem diameter, but at the expense of the length. It has been found that low concentrations of 1.8 Cineole camphor cause cell division in the garlic plant [36]. The silverleaf herb extract reduced the dry weight of the weeds in both seasons, while the Water hyacinth increased the dry weight of the weeds in both seasons (Table 4). The reason may be attributed to the inhibition of the genetic material of the varieties to express themselves under the influence of allelopathic tension with different concentrations. It was found that allelopathic compounds compete with other compounds in the second light system at different concentrations and for several genotypes [37]. This is in line with the statements of [38] who showed that spraying the extracts after 30 and 60 years of planting increased the yield components in wheat by decreasing the density of the weeds and its dry weight. The concentration increased by 5 mg L<sup>-1</sup> from 1000 seed weight in both seasons and total yield in the fall season (Tables 7 and 8). Also, the concentration increased by 15 mg L<sup>-1</sup> of the number of seeds and the weight of 1000 seeds and the total yield in both seasons (Table 6, 7 and 8). Or catalyzing other processes such as dry matter transport, collection and deposition in seeds. The reason may also be attributed to the fact that the genetic material of the varieties differs in expressing itself and showing its ability under allelopathic stresses by increasing the concentration, as the low concentrations act as growth-stimulating substances in which the genetic material works normally under its influence. The quotient is like the characteristic of the disc diameter (Table 5).

#### 4. Conclusion

This trial illustrated that water hyacinth and silverleaf nightshade extracts possessed more effective inhibition on weeds dry weight. Spraying the two weeds extracts effect was propositioned to the extracts concentration. The inhibitory effect was due to extracts content of allelochemicals. Growth of sunflower was also effected by extracts which depended on species of extract was led to yield components be effected. The low concentration were positively effected on yield components. Finally, weeds that have allelopathic properties need to be accurately managed.

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