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USING DIFFERENT METHODS OF ADDING HERBICIDES IN CONTROLLING WATER HYACINTH (*Eichhornia crassipes*) AND REDUCE IN WATER ENVIRONMENT POLLUTION

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Abstract

The experiment was conducted during the growing season 2017 at Baghdad (Iraq). The aim of study is controlling Water hyacinth and decrease pollution in water by using two herbicides, glyphosate and 2.4-D in a different concentration. The experiment application was set out as factorial experiment in randomization complete block design with three replicates and three factors:1-the types of herbicides with different doses and different methods application, 2-the replication of controlling and 3-the duration time, to get the readings after controlling. The results showed that Glyphosate herbicide it more effective than 2.4-D in reducing fresh weight plant and in percentage of disreducing regrowth up to 17.59% in all durations after controlling. The addition of the wiping gave results similar to the spraying method during different time periods and gave same result with spraying in different period specially when use Glyphosate in rate (1:10) and (1:5) (herbicide: water) concentrations and decrease pollution. It was observed that the period between two applications of 15-30 days is more favorable for controlling water hyacinth plant in which it gives 92.13% control when using glyphosate at dose of 450 g/acre when applied as spray or wiping.

Key words*: water hyacinth, Glyphosate, 2.4-D, wiping, pollution.*

INTRODUCTION

Water hyacinth plant is the one of an aquatic weed perennial, floating plants on the surface of the water, scientific name is *Eichhornia crassipes* (Mart) Solms-Laubach, belongs to the family *Pontederiaceae*, native to the Amazon River Basin in Brazil, he having the ability to live in different types of water (Center et al., 2005).

Currently spreads in more than 50 countries between latitudes 39 North latitude and 39 in the South (Martinez, Gomez, 2007).

It's one of the most dangerous invasive aquatic plants, and is one of the 100 most dangerous plants in the world ranked 20 among them (Crooks, 2002; Villamagna, 2009) it grows in the form of a thick, broad vegetative mat on the surface of the water and a large root mass that spreads under the surface of the water.

It is be a large biomass of in a short period of time it's a height (50-100 cm) and increases in height with plant density (Tellez et al., 2008; Williamns et al., 2005). This plant has two ways of reproduction the first vegetative method, the asexual reproduction by daughter plant, and the second reproduction is sexual reproduction by seeds (Julien et al., 1999) with the temperature suitable for him of 28-30°C (Center, Dray, 2010).

It is fast responsive and adaptive to environmental changes and severely affects the aquatic ecosystem as a result of blocking light access to other aquatic plants, it absorbs large amounts of dissolved oxygen, which negatively affects aquatic life (Khalil et al., 2009).

Water accounts for 93-96% of plant weight, increasing the rate of transpiration by 2.67-3.2times (Supmaneenan, 2003).

It is the host of many insects that affect human health, such as mosquitoes that transmit malaria and cholera and have a negative impact on water quality (Jones, 2009).

This plant entered Iraq in the mid-eighties and became the presence of this plant in a few years a growing problem day by day, characterized by its ability to reproduce and rapid spread under the conditions of the Iraqi environment from the South to the North and one of the most successful methods used in combating it.

The most important herbicides used are Glyphosate and 2.4-D which have proved very successful in reducing the growth and spread of this plant (Smith et al., 2004; Yirefu et al., 2007).

Chemical control was caused water pollution. The aim of the study was to use the chemical control of this weed with both the glyphosate herbicide and 2.4-D with different combinations and using the wipe machine.

MATERIALS AND METHODS

Basin with 1×1.5 m with a depth of 35-40 cm were used in the soil and used the agricultural plastic to covered this basin and it cut to separate between experimental units 1-1.5 m and the distance between the repeater and the other repeater is 2 m in order to avoid the transfer of the herbicide (Table1) from one experimental unit to another.

There are 9 variants (Table 2).

To the end of the experiment and cultivated with water hyacinth plants homogeneous in age and density and height of 25-35 cm, and it was identified area affected by this plant in the Tigris River as a second site to apply the experiment.

Table 1. The trade name, the common, the ratio of the effective material and the rate of use of the herbicides of the experiment

Trade name	The common name	Active ingredient	Rate of use: cm^3 effective material / ha for weed perennial
Touchdown S4®	Glyphosate	36%	1,440-1,800 (age 1-2 years) and 2,160-2,880 (2 years and above)
Difor Amine 72 SL	2.4-D	72%	1,080-1,800

Table 2. Transactions combating with different ways of reducing environmental pollution with repeated controlling

Experiment Factors	Variants
1. Control coefficients 2. Repeated addition(once and twice)	T1 Comparison without herbicide (water spray only)
	T2 (glyphosate spray) Surface spraying with recommended concentration (450 g active ingredient / acre)
	T3 (herbicide 2.4-D) Surface spraying with recommended concentration (360 g active ingredient / acre)
	T4 (glyphosate herbicide added by a 5: 1 herbicide to water)
	T5 (glyphosate herbicide added by a 10: 1 herbicide to water)
	T6 (glyphosate herbicide added by a 15: 1 herbicide to water)
	T7 (herbicide 2.4-D added by a 5: 1 herbicide to water method)
	T8 (herbicide 2.4-D added in a 10: 1 concentration of herbicide to water)
	T9 (herbicide 2.4-D was added in a survey method with a concentration of 15: 1 herbicide to water)

The process of adding or spraying of the herbicide solution when applying the treatment. The water hyacinth plants in the experimental units were wiping in opposite directions using the wiping machine manufactured as shown in Figure 1 where the water hyacinth plants are cleared for wetness as a result of contact with the cotton tissue, concentration (5:1), (10:1) and (15:1) herbicide to water (volume/volume) and opposite directions to pass on the leaves of the plant without contact with water. In spraying method, it was used the dorsal spray. Components of the manual wiping machine: 1- The herbicide solution tank is a PVC plastic pipe length 150 cm diameter 2 inch; 2- contact part (survey group) which represents the work width or the wiping interface 150 cm length; 3- holder for machine is a tube light weight of iron at length 180 cm; 4- lumbar fabric.


Figure 1. Method of using manual wiping machine to add chemical herbicides to control water hyacinth

The data obtained from the water hyacinth plants.

a. Dry weight of water hyacinth plants for area of one m^2. The dry weight was calculated after 15 and 50 days of control.

b. Measuring the percentage of water pollution caused by the control, after one day for control Water samples were taken from each experimental unit to measure the percentage of water pollution caused by the use of two methods of addition to spray and wiping and by knowing the wavelength of each herbicide where the samples are read by the spectrophotometer and recording the readings of the device (Absorbance) per sample. The obtained data analysis from the field experiment according to experiments method randomized complete block designed (RCBD), using a computer according to a program (SAS) and using test Duncan multi-Range was used to compare the experimental averages, obtained in field for comparing the averages before and after flowering of water hyacinth plants, the differentiate averages that are different from each other in letter different in the level 0.05 according to (Al-Rawi, Abdul-Aziz, 1980).

RESULTS AND DISCUSSIONS

Effect of control coefficients and repeats and time periods after control in dry weight (g/m^2) for water hyacinth plant. Table 3 shows that the glyphosate gave a significant difference in decrease the dry weight of the water hyacinth plant compared to the surface spray of herbicide for 2.4-D and the difference rate of 78.3%. When comparing surface spraying with the wiping of glyphosate method, there were no significant differences between T2 (surface spray of glyphosate herbicide), T5 wiping method (1:10 herbicide: water) and showing don't significant differences between T4 (1:5 herbicide: water), T6 (1:15 herbicide: water). In both cases (spraying and wiping) of the glyphosate gave desirable results compared to the comparison treatment. In general, the superiority of the glyphosate in the wiping method was observed on all survey coefficients of herbicide 2.4-D and the relationship between surface spraying and the wiping of herbicide 2.4-D. Table 3 indicated that the wiping method was superior in T7 (1:5 herbicide: water) on the rest of the transactions indicating that the use of high concentration in wiping is better than spraying the herbicide. This result is consistent with the findings of the (Fryman, 2009).

Table 3. Effect of control treatment, number of addition times and time periods after control and interference between these factors in dry weight (g/m^2) of water hyacinth

Effect of time periods	Effect of addition times	Effect of interference between number of times and treatment	Number of days after control			
			50 days	15 days		Number of times addition
			1975.5 a	1323.3 c	once	
			1051.3 d	1678.2 b	twice	
	1649.37a	3713.3 a	4141.3a	3285.3 b	T1	once / Treatment x The number of times
		645.3 h-i	325.3 m-o	965.3 h-m	T2	
		2088b c	2373.3d-c	1802.7 d-g	T3	
		621.3 h-i	816 j-o	426.7 m-o	T4	
		810.7 g-h	880 i-o	741.3 k-o	T5	
		1272f g	1861.3 d-f	682.7 k-o	T6	
		1594.3 d -f	2042.7 d-e	1056 g-m	T7	
		2013.3 b-d	2432 c-d	1594.7 e-i	T8	
		2131 b	2907.3 b-c	1354.7 e-k	T9	
	1364.74b	3712 a	2880 b-c	4544 a	T1	twice / Treatment x The number of times
		197.3 i	165.3 o	229.3 n-o	T2	
		1796.7 b-e	1722.7 d-h	1850.7 d-f	T3	
		837.3 g-h	357.3 m-o	1317.3 e-k	T4	
		232 i	266.7 n-o	197.3 n-o	T5	
		773.3 g-h	592 i-o	954.7 h-n	T6	
		1336 e-f	1088 f-m	1584 f-h	T7	
		1818.7 b-e	1205.3 f-k	2432 c-d	T8	
		1589.3 c-f	1184 f-k	1994.7 d-e	T9	

	T9	T8	T7	T6	T5	T4	T3	T2	T1	Number of days
1500.54a	1674.7 b-d	2013.3 b	1320 c-e	818.7 f-g	469.3 g-h	872 e-g	1826.7 b-c	597.3 g-h	3914.7 a	15 days
1513.37a	2045.7 b	1818.7 b-c	1565.3 c-d	1226.7 d-f	573.3 g-h	586.7 g-h	2048 b	245.3 h	3510.7 a	50 days
	1860.2 b	1916 b	1442.7 c	1022.7 d	521.3 e	729.3 d	1937.3 b	421.3 e	3712.7 a	Effect of treatment

The value with the same letters is not significantly different from each of the study factors and at each interference at a probability of 5%.

The addition of the herbicide in two batches is better than adding the herbicide once and may be due to increased lethal dose when adding twice the dose of one-time killer, there were no significant differences between the average number of days after control (15 and 50) days, which indicates that the effectiveness of the herbicide is continuous and that the plants are under the influence of the herbicide even after 50 days of control. This result is good because the target is not only the temporary killing but the sustainability of the herbicide effect. The results showed significant differences in the interference between recurrence of the addition in the number of days after the control and gave the treatment of the addition twice after 50 days of control best results in reducing the dry weight of the plant compared with 15 days after, but reverse when it addition one time, it was showed with an increase in dry weight after 50 days compared to 15 days after control.

There was also a significant differences between the addition repetition and the control treatment. It was observed that the best treatment to achieve the dry weight reduction of the water hyacinth plant was for the glyphosate when addition repetition, the treatment was T2 (surface spraying glyphosate) and T5 (1:10 herbicide: water) was 197.3 and 232 g/m^2 respectively, while the treatment of T9 (1:15 herbicide: water) was 2.4-D highest dry weight when added once or twice and amounted to 2131 and 1589.3 g/m^2, respectively. In general, herbicide 2.4-D showed less effective results in reducing dry weight, either by spraying or wiping compared to the glyphosate. It is also showing from the wiping treatments that the glyphosate treatment of T5 (1: 10 herbicide: water) was distinguish by high efficiency in reducing the dry weight of the water hyacinth plant taking into account the volume, age and density of the plant in the area

unit. The results showed significant differences in the number of days after control and control factors. It is clear that the results of the glyphosate are better than the herbicide 2.4-D and that the efficacy of the glyphosate herbicide lasts longer than the herbicide 2.4-D where the ratio between spray of glyphosate and 2.4-D compared to comparison treatment after 50 days of addition to 93%, 41.7%. There was no significant difference between treated T2 added by spraying method, T4 (1:5 herbicide: water) and T5 (1:10 herbicide: water) added by wipe after 50 days of control can be replaced by spray method to wipe and this is an important indicator of the success of one of the objectives.

Research to reduce environmental pollution caused by herbicide spraying. The results showed a significant difference between the repetition of addition and the control treatment in this adjective it was showed a herbicide surface spray glyphosate is superior in addition twice on the one-time addition where it gave a control ratio of 94.38 and 81.37%, respectively, the method of wiping was superiority in the same herbicide in concentration of (1:5 herbicide: water) for one time added and the wipe method in concentration (1:10 herbicide: water) for two time addition, and these ratios are good in control operations, especially those whose proportions are more than 90%. The herbicide 2.4-D showed a lower efficiency in the killing than in the glyphosate herbicide. However, the best treatment for this herbicide was observed when spraying the herbicide twice and the wipe at a concentration of T7 (1:5 herbicide: water). When comparing between the two herbicides in spraying method, the difference between them 36.05% for the addition of one time and 44.4% for the repeat control while the difference between the best treatment of the glyphosate herbicide was T5 (1:10 herbicide: water) and the wipe method 2.4-D T7 (1:5 herbicide: water) when the wiping repetition to 29.08%. The results in Table (3) showed a significant interference between the number of days after the control and the control treatment. The best control treatments at 15 or 50 days were in the treatment of spraying of T2 (glyphosate surface spray) and wiping in concentration T5 (1:10) and in general, there are no significant differences in the herbicide, either by spraying or wiping method because its efficiency lasts for 50 days, for the herbicide 2.4-D, the treatment in concentration of T7 (1:5 herbicide: water) is better than the spray treatment after 15 or 50 days after the control. The difference between the glyphosate herbicide and the herbicide 2.4-D surface spray after 50 days gave a difference of 49.4%, while the wiping for the same period and at the concentration of (1:10) of the herbicide, reached 35.3%. Indicating that the efficiency of the glyphosate herbicide, either by spraying or by wiping, is better than that of herbicide 2.4-D in the control ratio. Table 3 shows a significant difference the triple interference between the experimental treatments. The results showed that the treatment of the glyphosate spray surface and wiping T5 (1:10 herbicide: water) was treated twice after 15 and 50 days after the control, in addition to the treatment of the glyphosate spray surface for once after 50 days of control that the lowest proportion of control was observed in the following treatments. Treatment of 2.4-D surface spraying and once after 15 days of control, herbicide 2.4-D added on concentration T8 (1:10 herbicide: water), twice addition 15 days after control and 2.4-D in T8 treatment (1:10 herbicide: water) one time after 50 days and surface spraying of the same herbicide after addition to twice in 50 days after control. The results show that the glyphosate herbicide is better than the herbicide 2.4-D in the killing and repetition the spraying of the glyphosate herbicide or treated with a concentration of T5 (1:10 herbicide: water) gives sustainability longer and kill more and preferably the wiping on spraying. It is also not preferable to increase concentration in the wiping method if a herbicide 2.4-D is used add in wiping better manner than spraying, especially at the concentration T7 (1:5 herbicide: water).

Effect of different addition methods for the herbicides used in the control in percentage of pollution in water. Figure 2 indicate that the stagnant water contamination levels when using the wiping method for addition of the glyphosate herbicide with a concentration of 1:5 herbicide: water (T4) is the lowest compared to other concentrations, although there are no significant differences in wiping

method. While the treatment of the addition of this herbicide in a spray method with a concentration of 450 g (effective substance)/ acre it gave a pollution of 0.314 mg/l. indicating that spraying method to plants caused high levels of pollution both in the first and second readings.

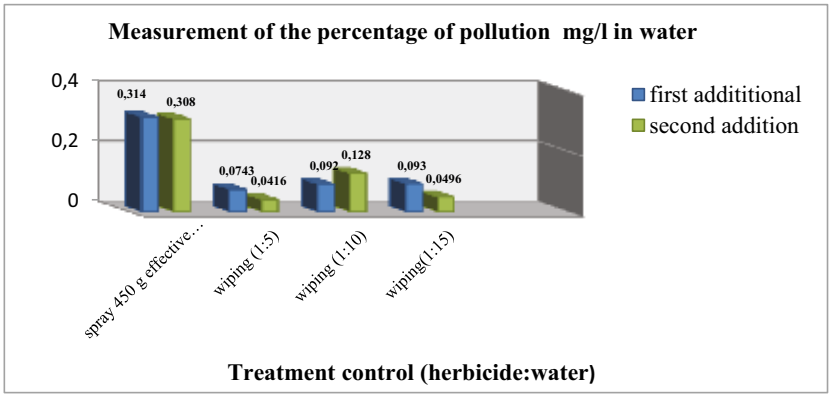

Figure 2. Measuring the percentage of contamination (mg/l) in water resulting from the addition of the glyphosate herbicide using the conventional spraying method and the wiping method in the control of the water hyacinth plant in 2017

We conclude that the wiping method reduced pollution by up to 76% for the first reading after one day of the control and 86.05% after one day of repeated the control, taking into consideration that the process of adding the wipe was done by using the paint roll in opposite directions compared to the use of special equipment designed for this purpose, it will also reduce the percentage of pollution better. The allowed pollution rate of the glyphosate herbicide is 37 mg/l (Ashwini et al., 2007). And for the herbicide 2.4-D it was observed that the percentage of pollution, whether by spraying or wiping, is higher than in the glyphosate herbicide (Figure 3), in general, the rate of surface spray contamination, especially after one day of the first control, reached 77.2% compared to the wipe at the concentration of T8 (1:10 herbicide: water) it 92.8% in the second reading. The lethal dose (LD_{50}) of this herbicide is 639 mg/kg on rats (US EPA, 2005).

We conclude from this that the method of wiping is better than the spraying method for both herbicides, taking into account the use of appropriate concentrations to lead to the process of killing the water hyacinth plant at a high rate and achieve the lowest percentage of pollution in stagnant water, noting that this percentage of pollution depends on the rate of plant density of water hyacinth, which covers the water areas and the height of the plant on the surface of water and the total number of vegetative and depends on the rate of wax covering the leaves, which causes the drop of spray droplets from the surface treatment, which may increase the percentage of pollution and the speed of control in addition to the experience of the control and the efficiency of the machine used. It is important to note the type of herbicide used since there is a percentage of non-effective substances added to the herbicide at manufacturing, including wetness factor or adhesion to the surface of the leaves is of great importance in the aquatic weeds control and reduce the proportion of pollution to the extent that does not affect the aquatic environment. *Comparison of the efficiency of addition wiping with spraying method in reducing pollution*. Figures 2 and 3 showed that the efficiency of the wiping method was significantly higher in the reduction of the pollution resulting from the arrival of the herbicide to the water after the day of the addition of the first and second compared to the method of spraying and both the herbicides. Indicates the effectiveness of this method in achieving control on this dangerous weeds.

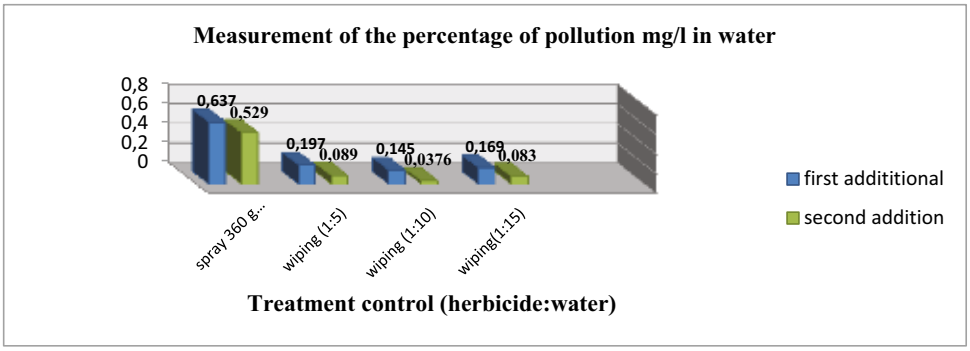

Figure 3. Measurement of the percentage of contamination of water (mg/l) resulting from the addition of herbicide 2.4-D using the spraying method and the wiping method in the control of the water hyacinth plant in 2017

CONCLUSIONS

The Glyphosate herbicide is better than the herbicide 2.4-D in the killing and repetition the spraying of the glyphosate herbicide or treated with a concentration of T5 (1:10 herbicide: water) gives sustainability longer and kill more and preferably the wiping on spraying. It is also not preferable to increase concentration in the wiping method if a herbicide 2.4-D is used and add in wiping method it better than spraying, especially at the concentration T7 (1:5 herbicide: water). The efficiency of the wiping method was significantly higher in the reduction of the pollution resulting from the arrival of the herbicide to the water compared to the method of spraying.

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