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ECOLOGICAL AND BIOLOGICALSTUDY OF WATER HYACINTH [*EICHHORNIA CRASSIPES* (MARTIUS) SOLMS-LAUBACH] IN ABU - ZIRKMARSH (SOUTHERN IRAQ)

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ABSTRACT : The study was carried out in laboratories of the Marsh Research Center University of Thiqar during growing season of *Eichhornia crassipes* (Mart)Solms from April 2017 to November 2017three stations were chosen in this marsh, many measurements were taken such as (wet weight, total plant length, root length, number of leaves, number of daughter plant, number of flowers, amount of water evaporation and relationship to development of quality growth).Alsowater quality and heavy metals were measured from three station The results showed that the wet weight of the water hyacinth from the beginning of cultivation in laboratory from April to November were (15 g - 255 g), the total height (16 - 52 cm), the root length (11-30) cm, the numbers of leaves(5-80), numbers of daughter plant (2-24), numbers of flowers (1-9)and the rate of water evaporation between control and evaporation in the container with water hyacinth about 0.5 - 4.5/L daily through study period. The staticalmethod showed thatsignificant differences were recordedbetween the development of plant growth and the environmentalconditions (water temperature, air temperature,Relative humidity %).Theresultsobtainedthat the wet weight of water hyacinth in field was (150- 10750g/ m^2),total height plant reached to (22-60 cm), root length reached to (15-38 cm)and the leaf area reached to (650.0 leaves /m^2).

Key words : Environment, Water hyacinth, Abu zirk marsh, invasive species, aquatic plants.

INTRODUCTION

Water hyacinth was found across tropical and subtropical regions originally from the Amazon basin, and its entry into Africa, Asia, Australia, and North America has been facilitated through human activities (Dagno *et al*, 2012). Since the end in the 19th century, plants have taken hyacinth from their origin to all over the world as garden plants (CABI, 2015, Tegene and Ayele, 2014). This weed has been identified as one of the100 most aggressive invasive species and recognized as one of the top ten worst weeds in the world (Patel, 2012).The water hyacinth found its way to rivers, lakes, and dams reservoirs, irrigation, and drainage throughout the tropics and subtropical regions then it became a harmful herb (CABI, 2015). Water hyacinth is belongs to the family Pontederiaceae, monocotyledon and, aquatic macrophyte, free floating with beautiful clusters of violet and yellow flowers and bulbous green leaves.Water hyacinth has broad, thick, glossy, ovate leaves and may rise above the surface of the water as much as (1 meter) in height (Adegunloye *et al*, 2013). The leaves are (10-20 cm) across and float above the water surface. They have long, spongy and bulbous stalks. Each plant consists of a rosette of six to ten leaves attached to a rhizome with a well-developed fibrous root system (Hill *et al*, 2011). A stalk bears a single spike of 8-15 attractive flowers, mostly lavender to pink in color with six petals.Reproduction sexually by seeds and vegetatively by budding and stolen. Both reproduction has producing large number of individuals in a small period of time (Barrett, 1980). Under normal conditions, water hyacinth can grow at a rate of 0.26ton dry biomass per hectare per day (Kunatsa *et al*, 2013, Khatun *et al*, 2014, Sai *et al*, 2015, Guerena *et al*, 2015). Theoptimum temperature to growth of water hyacinth was is 28-30°C (Burton *et al*, 2010) and the optimum pH is 6 to 8 (DiTomaso, & Healy, 2003; Wilson *et al*, 2005). *Eichhornia crassipes* was first appeared in Iraq in the mid-1980s, in Baghdad in the army channel.The first flowerpots, taken by some private nurseries, (Abdulrazzak, 2017), and did not make serious efforts to

get rid of them at an early date. After then spread to the Diyala river and parts of the Tigris river and reached the province of wasit (presiding over the Kut) (Shaker, 2010). It has also proved its presence in the Gharraf river, the Husseiniya river, Tigris river and many other rivers, canals in the governorates of Diwaniyah, Karbala, Babel, Maysan and governorate Salah Al-Din in the (Dams Samarra). Since then, governorates of Kut and Samarra have taken some methods of treatment to combat them, but because of their nature and spreadthe problem has returned in recent years (Al-Wagga, 2012). Water hyacinth has not only been identified in rivers, but attacked marshes looking to increase their share of water, especially after entering the protected world heritage, in July 2016 Including Abu Zirk marsh, which exposedto the invasion of water hyacinth. The total area of Abu Zirk marsh during the last two years and after decreasing the amount of water to 118 square kilometers. The amount of area infection with water hyacinth plants was about 2265875 square meters and thus the percentage of reached to 18% (Marshlands Rehabilitation Center, 2018). The rapid and intensive growth of the water hyacinth plant has caused environmental and economic damage in the Abu zirk marshe, such as including the restrict boats traffic in the marshes, preventing fishermen from throwing fishing nets, obstructing the flow of water inside. This study is considered the firstand databaseto assess of the nature growth of water hyacinth under the environmental conditions in Abu Zirk Marsh (southern Iraq), because the entry of this plant to the Marsh in 2016 and there was no serious study on the knowledge of the conditions of rapid growth in this marshes. The aim of this study is to evaluate the reproductive and productive capacity of the water hyacinth plant under the environmental conditions of the southern Iraq marshes and to consider it as a database for assessing plant growth in this environment, and also estimate the amount of water consumed by water hyacinth during the growth and transpiration and know the amount of water lost in the marshes, as well as to propose recommendations for the future management of the Marshlands, thereby enhancing understanding of the water hyacinth dynamics and their environmental and economic impacts.

METHODS

Description of the study area

Abu Zirk marsh is located in Al-Islah District (50 km) east of Al-Nasiriyah city. It stretches along Al Fuhud district,at to the northwest of Al- Nasiriyah city, also with the central marshes at the end of the tail of Al- Gharraf river (the most important distributor from Tigris to Euphrates river) south of Al-Islah district. The marshes are located in a natural depression of an estimated size120 million cubic meters. the main water supply to the marshes through Shatt Abu Lihya and the channel of this river pass through the marsh until it dissipates at the tail end in the large marshes, in addition, the marshes are fed through three separate channels (Al-Ramida, Al-smaisim, and Abu Al- Jurry,)all of which originate from Al- Gharraf river In the north, next to the Islah district. Rivers feed the marshes along the North end. The marshlands collapse on the left bank of the Euphrates river in the Al- Fuhud district,and the marsh is filled with grasses of reed, papyrus and run through by a stream of a head calledShatt Abu Lahya (in addition to other branches called) Abu Sameesm, Abu Glaoan and Nasriy(New Eden,2014) Figure (1).

Collection of water hyacinth plant

The study was perform in the laboratory of Marshs Research CenterUniversity of Thiqar, Southern

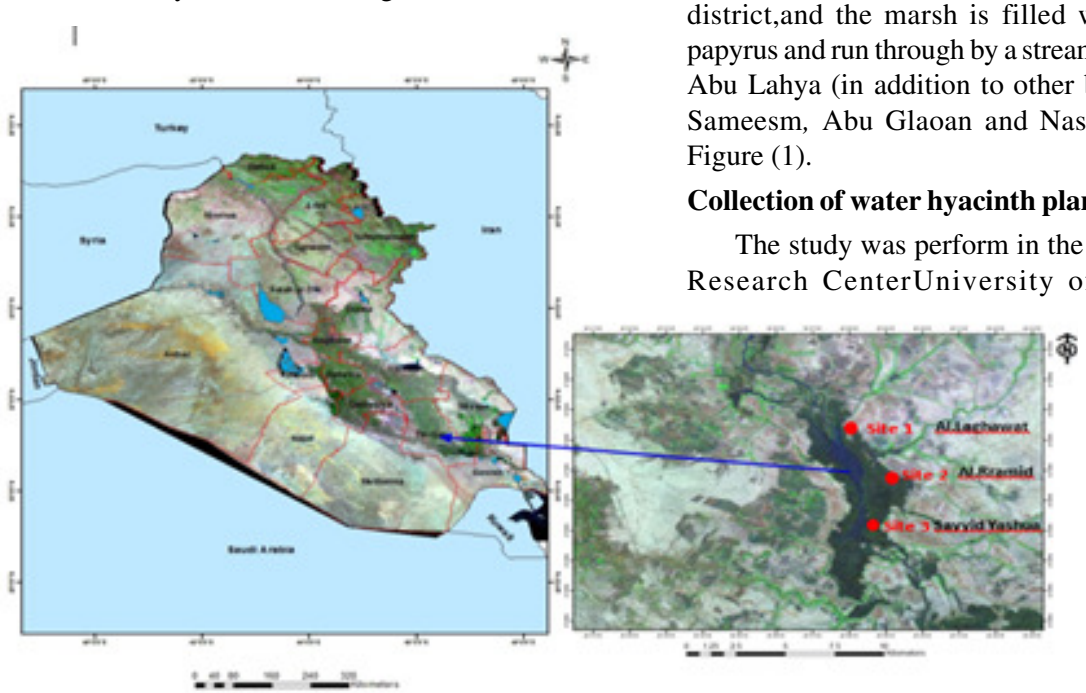

Figure 1 : Map of study area in Abu zirk marsh (Google Earth, 2018).

Iraq,during the grew of water hyacinth from April 2017 to October 2017 plant samples were collected from three different stations in Abu Zirk marsh samples were transferred by nylon bags to the laboratory and Plants were rinsed several times with water to remove attached organic and inorganic matter and macro invertebrates or periphyton in the roots and leaves. In order to acclimation, the plant and follow the growth take (one daughter plant of water hyacinth) had planted in plastic containers measuring (45cm x 35cmand depth20 cm)(Al-rubaie, 2015). And fill a soil from the same sites was weighed with a kilogram of weight with (addition of water 10 liters), and provided with an oxygen compressors throughout the study period plants were placed in plastic container one planthomogeneous in weight and size as threereplicates for each plant and a rate of 12 per site . Characterizes had taken such as wet weight / gm,total length of plant / cm,total length of root/ cm, numbers of leaves / cm, numbers of daughter/plant, numbers of flowers /plant) addition to the daily monitoring of air and water temperatures by using the following parameters (0-100 digital thermometer) and the relative humidity ratio, To compare the water hyacinth consumption by water evaporation or transpiration, three plastic containers free of the plant as (control) fill a soil from the same sites was weighed with a kilogram of weight with (addition of water 10 liters), and provided with an oxygen compressors throughout the study period,plants were placed in plastic container one planthomogeneous in weight and size as threereplicates for each plant and a rate of 12 per site

Field Growth Experiment

Five identical daughter plants of the weight and size were randomly selected from the marsh in cages constructed from metal poles of ¾" PVC and nylon mesh in In a measured area of the earth area ($2m^2$width× $2m^2$ length × $1m^2$ height)and nylon nets on the basis of the methods described by Grecco and de Freitas (2002)and Rotella(2010)They were a cage placed in the marsh and was fixed in the bottom of marshes. Plant growth measurements were taken during the growth period (May 2017 to October 2017) the measured consist of wet weight g / m^2, total length plant/cm, root length/cm, number of leaves. And leaf area m^2)

Physical and chemical measurements

The quality of the water was studied by collecting water samples from three different sites in Abu zirk marsh, physical and chemical parameters were measured by using a multimeter portable advise - HANA (water temperature, air temperature, pH, TDS, Ec), BOD, but Do,was determined using Winekler titrimetric method (Mackereth, 1963)., Depth of water using a metric scale, intensity of light using a sachi disk, alsowatersamples was transferred to the laboratory by polyethylene bottle with preservation at 4 until laboratory analysis of water quality was conductedNa^+,Ca^+,Mg^+,Cl^-,HCO^-,$CO3^-$,$SO4^{-2}$ $PO4^{-2}$, $NO3^{-1}$,COD)also the measurement consist of heavy metals(cu,zn,Mn,cd).

Statistical analysis

P<0.05 was chosen as a level of significance for all analyses. SPSS version 17.0 was used for all statistical tests.

RESULTS AND DISCUSSION

This study is considered as a database showing the rapid growth and reproduction of water hyacinth under the natural environmental conditions in Abu Zirk marsh during the period April 2017 to November2017. Physical, chemical and heavy metals studied the water quality of Abu Zirk marsh which has an effect on the speed Reproductionof water hyacinth. Table (1) show the significant differences in the level of p <0.05 between parameter measurements of water quality and its effect on the growth and reproduction of water hyacinth in site (1,3,2) such as (water temperature, air temperature, light penetration,pH,EC,TDS,BOD_5), and some chemical parameter consist of $PO4^{-2}$,$NO3^-$Which are important on nutrientsfor plant growth.

Table (2) show the significant differences in the level of p <0.05 between the studied plant growth through the period in April 2017 to October 2017 in laboratory were their wet weight(15-255 gm/cm) .Total length of plant (16 -52/ cm),total length of root (11-30/ cm) with physical parameter (water temperature, air temperature and Relative humidity %).

While The results of the field-based experiment found differences between the plant characteristics studied in the field and the environmental factors are shown in Table (3). There are significant differences between the wet weight of the plant (150-10750 gm/cm^2), the total length reched to (22-60 cm/m^2), the root length reched to (15-38cm/m^2) and the leaf area/m^2) with the some environmental factors affecting the growth speed such as air temperature, water temperature and relative humidity % in the Abu-zirk marsh

Table (4) shows significant differences in the level of p<0.05 between the physical properties (water temperature, air temperature, relative humidity%) and their effect on water evaporation rate in the comparison continuer (free of water hyacinth) and the evaporation rate in container containing water hyacinth between them ranges(0.5- 4.5)L/day. Depending on how different temperatures and relative humidity are during the growth

Table 1 : Physicochemical parameter of water quality in Abu zirk marsh during 2017.

Month	S	AT ^{0}C	WT ^{0}C	WD cm	Lp cm	PH	EC ìs/cm	DO mg	BOD_5 mg/l	T.S.S mg/l	T.D.S mg/l	Tur NTU	TH ppt	No3/ ppt	PÔ4 / ppt
May	**s 1**	37	23	150	30	7	*1120	3.3*	3*	450	*467	0.09	298*	5.06	37.9
	s 2	35	23	250	50	7.5	1182	7.0	3.3	443*	492	0.08	330	3.11	*64.355
	s 3	37	23	300	50	*8	1521	3.6	2.0*	580	633	0.09	321	3.31	18.387
June	**s1**	37	23	150	30	7	1143	3.5	2.3	450	475	0.08	280	3.41	6.129
	s2	35	23	250	50	7	1150	7.0	4.6	455	482	*0.04	285	*7.52	21.452
	s3	37	23	300	73*	7.5	1176	5.0	5.1*	460	493	0.09	261	5.87	18.387
July	**s1**	41	32	136	17	6.9	1428	*11	2.4	574	602	53.4	562	2.43	0.04*
	s2	39	33	121	24	7.8	1420	10	2.2	486	593	44.1	528	3.50	0.38
	s3	40	34	300*	58	7.8	1391	10	2.2	477	597	32.6	536	2.55	0.43
August	**s1**	41	32	100	30	7	2410	9	4	878	1071*	55.6	600	6.41	0.39
	s2	44*	33	105	30	7.5	1506	8	3	498	671	55.7	540	3.42	0.37
	s3	43	30*	115	25	7.8	1724*	6	4	563	767	35.7	550	2.81	0.45
September	**s1**	34.1	27.1	134	13	7.7	1300	8	4	472	692	119*	450	1.23	0.43
	s2	35.2	27.5	82	18	7.9	1249	5	2	510	684	67	430	1.12*	0.42
	s3	34.7	29	120	24	7.8	1477	8	3	524	764	23	475	1.42	0.52
October	**s1**	30	21	80	30	7.8	1379	6	4	569	717	30	650*	3.91	0.40
	s2	27	13	100	38	7.9	1376	6	4	670	716	22	620	3.61	0.43
	s3	25	14	90	37	6.6	1360	7	5	673	711	19	600	3.44	0.38
November	**s1**	23	14.7	40*	10*	7.3	1532	7	5	875	944	19	564	5.06	37.9
	s2	21*	12	50	13	7.4	1522	6	3	888*	941	11	525	3.11	64.355
	s3	22	11*	40	12	6.6	1516	6	3	850	937	9	530	3.31	18.387

(s) station,(AT)Air temperature, (WT): Water temperature , (RH%) relative humidity %,(Wd)water depth ,(lp) light penetration , (Tur) turbidity (*)) significant > 0.05

period.

The water hyacinth was measured under environmental conditions in the Abu Zirk marsh . Where environmental factors played important role in the rapid growth of plants. During the first months in laboratory and field experiment the wet weight was observed and the monthly increase from July to October 2017 the increased due to the increase in the number of leaves and the number of daughter of the water hyacinth during growth period, root length, and plant height. All these characteristics led to a cumulative increase in wet plant weight (Supmaneenan, nattapong 2003). This increase in the level of nutrients, especially nitrogen and phosphorus, is stored in the plant tissues and after the plant dies, it decomposes and returns to the water to be absorbed by the plant . Also affected by water temperature, air temperature and relative humidity (Reddy and Sutton, 1984) and also Play an important role in the speed of plant growth and increase the wet weight of the plant.

The highest plant was increase in the July, August and September with 34, 48, 52 cm in the laboratory and the field experiment 40, 48, 57 cm, these results due to the effect of indicating weather conditions, including temperature during the month of July,August and September was suitable. Some research indicates that the decrease of plant height due to Consumption of nutrients in the formation of other vegetable o then rgans does not mean discontinuation in growth.(Methy, Roy, 1993). The results showed that temperature is not important in the characteristics of root length, but may depend on the availability of nutrients as well as on the depth of the water, therefore shortens the root in clay and salt water (wright, Purcell 1995), The root length has a clear and significant relationship with the number of daughter and leaves area. This causes the root length to increase the ability of the plant to take advantage of the largest amount of the nutrients present in the environment and to provide the vegetative part of the water hyacinth for a high efficiency of growth (Didham 2005). The daughter Plant is one of the most important characteristics of the plant in the process of reproduction and many studies have pointed to the activity of this characteristic according to the availability of nutrients and the intensity of light and the environment appropriate (Gopal 1987).

The laboratory study showed a significant relationship with the wet weight and the number of leaves. The number of daughter plant in the month of July under laboratory experiment reached to 16 daughter. The result is that the plant has a great ability to represent the nutrients to in organs of water hyacinth. The increase in the number of

Table 2 : Growth of water hyacinth in the laboratory during 2017.

DATA	ATC	WTC	RH%	Ww	Tlp	Tlr	NO.L	NO.D	NO.F
1/4	34	24	33	15*	16	11	5*	0	0
1/5	38	27	20	45	22	16	15*	2	1
1/6	40	29	17	80*	27	20	40*	6	2
1/7	47	32	16	*105	34	23	60*	16	5
1/8	44	24	17	170*	48	25	75*	24	6
1/9	37	25	20	220*	52	26	77*	24	8
1/10	23	20	34	255*	52	30	80*	24	9

AT : Air temperature, WT: Water temperature , RH%: relative humidity %, W w: wet weight gm/cm ,T lp: total length of plant/ cm, TLr, total length of root, NO.L: Number of leaves , NO. d: Number of daughter plant , NO.F: The ,: AT,WT.RH The) significant > 0.05 * number of flowers in(each plan

Table 3 : Relationship between some physical factors on growth of water hyacinth in field.

DATA	ATC	WTC	RH%	Ww	Tlp	Tlr	NO.L	LA
1/4	34	24	33	15*	22	15	70	12.800*
1/5	38	27	20	150*	25	17	270	38.400*
1/6	40	29	17	450*	32	20	760	115.200*
1/7	47	32	16	1360*	40	30	2920	345.600*
1/8	44	24	17	5400*	48	35	7530	691.200*
1/9	37	25	20	9700*	57	37	950	672.000*
1/10	23	20	34	10250*	60	38	910	650.000*

AT : Air temperature, WT: Water temperature , RH%: relative humidity %, W w: wet weight gm/m^2 ,T lp: total length of plant/ cm TLr:, total length of root/CM, NO.L: Number of leaves/m^2 ,LA:Leaves area/m^2) (*)significant (0 > 0.05).

Table 4 : Relationship between water evaporation and physical factors.

DATA	ATC	WTC	RH%	Ww	Tlp	Tlr	NO.L	NO.D	NO.F
1/4	34	24	33	15	16	11		1.5	0.5
1/5	38	27	20	45	22	16	15	2.5	0.5
1/6	40	29	17	80	27	20	40	3.0	2.5
1/7	47	32	16	105	34	23	60	3.5	3.0
1/8	44	24	17	170	48	25	75	4.5	3.0
1/9	37	25	20	220	52	26	77	2.5	0.5
1/10	23	20	34	255	52	30	80	2.0	0.5

AT : Air temperature, WT: Water temperature , RH%: relative humidity %, W w: wet weight gm/cm ,T lp: total length of plant/ cm TLr, total length of root, NO.L: Number of leaves, E.W.P:Evaporation withe water hyacinth ,E.wt.p: Evaporation withoutwater hyacinth(*) ATWT) RH The difference is significant at the 0.05 leve

daughter plants means increasing the leaves area and increase the area occupied by the plant Theleaves area is limited, so we notice a gradual increase in leaves area during the months of growth and reached 650.00m^2 in October while in April 12.80m^2, so the leaves area is of great importance because it is the main source in the composition of carbohydrates as the leaves area increasedThe higher leaves area, the greater the composition of the other members of the body of the plant in addition to increasing the rate of storage in certain parts of the plant to maintain survival and re-growth when exposure to inappropriate conditions .

In order to determine the rate of consumption of the water supply, a laboratory experiment was conducted to compare the container on the water hyacinth plant and other container without the plant. In water consumption by transpiration or photosynthesis ranged between the highest water consumption rate in August and the lowest in April 1.5-4.5 liters, depending on the average temperature and relative humidity. The rate of evaporation rate of the air temperature it reached 0.5-3.5 liters in July.

CONCLUSIONS

The water hyacinth is able to consume a large amount of water during rapid growth activities and also when the process of transpiration reach up to 4.5 liters with high temperatures atmosphere.

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