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Research Paper

Investigation of Effects of Control Method on Immersed Aquatic Weeds

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Abstract

Chara Vulgaris and *Najas felexilis* both are immersed aquatic weeds; which found in stagnant waters rich in nutrient. Unlimited growth of these plants resulted in declining water use efficiency and could bear ecological and economic damages to the environment. In most of the fresh water systems such as lagoons, rivers and lakes, successful control of diverse weed species were demonstrated using mechanical methods. The aim of this study was evaluating immersed aquatic weeds response, C.vulgaris, and N.felexilis to cutting in three levels (no cutting, one-time cutting and twice) in Azadegan Park's lake of Tehran. the experiment performed as a factorial design in the base of completely randomized design with three replications. Measured characteristics included the height and dry matter evaluation in experimental plants.

Results showed that one time cutting in comparison to control treatment decreased C.vulgaris and N.felexilis as 43.75 and 13.8 %. Then twice cutting decreased plant growth and regeneration significantly rather than one-time cutting ($P \leq 0.05$). Results showed that the lowest dry weight reduction and height in two-time hew were observed in Chara.Vulgaris. So cutting off and its periodic repetition resulted in proper control effect on experimental plants due to inducing stress and reducing higher carbohydrate storage.

Keywords: Immersed Weeds; Azadegan Lake; Cutting off; Height and Dry Weight

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1. Introduction

Aquatic plants refer to all flowering ones, ferns, Bryophytes, and algae [1]. These are divided into 4 groups of Floating leaves, free-floating, immersed and root in water based on growing pattern and their establishment in the lake [2]. Plant presence in the aquatic environment causes critical cycles in aquatic ecosystems and their safety. Human intervention in most of the area resulted in changes in physicochemical structure and prepare condition for some opportunist plant species to grow massively and then converted them to weeds [3]. One of the main consequences of the massive growth of aquatic plants included avoiding light penetration into the water, reducing biodiversity, increasing transpiration and diminish water quality and fishing [4]. According to Barko et al (1986), understanding relations and ecological demands of these plants could help managers to slow down their growth or regrowth under damage threshold. Controlling aquatic weeds performed by mechanical, chemical and biological methods [1]. The lake of Azadegan Park by more than 53000 m2 extent is one of the largest artificial lakes in the country. This lake water supplies with under-ground sources (well), rural waste (south of Iran) and considered as a sink to irrigate green space of the park [1]. The massive population of weeds such as Ceratophyllum, Myriophyllum, Chara, Najas, and

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Potamogeton still cause problems like stench, insects, reducing water level, water tube obstruction due to proper environmental condition (nutrient, light and calcareous bed) [1]. Both *Chara vulgaris* and *Najas felexilis* respectively belong to Characeae and Najadaceae family of dominate immersed weed species in Azadegan Lake [5]. Chara and *Najas* genus nomination was respectively performed by C. Linnaeus and E. Boughey.

C.vulgaris is originally Multicellular algae and an aquatic plant which because of the same behavior or morphology with flowering plants, similar strategies used for its control [1].

Experimental results by Barko et al (1986), NI (2001), Adamec et al (2002) revealed that successful control strategies related to the environmental condition (light, bed composition, and nutrient) [4,6]. Regrowth strength of control samples increased in the presence of nutrients such as phosphorus and nitrogen. Both Chara and Najas had high capability to adsorb and storing these materials [3]. Mechanical procedures (like cutting off, rolling, reducing the water level, drainage, shading) are contemporary methods to control weed in the aquatic environment (artificial lakes, drainage channels, pools, ponds, and lagoons) [4]. Results obtained by Unmuth et al (1998), Cromwell (2008) and Filizadeh et al (2002) showed that using cutting off method resulted in significant reduction and eligible control of aquatic weeds such as *Thypha latifolia*, *Potamogeton pectinatus,* and *salvinia rotundifola* [2,7].

Azadegan lake considered as an irrigation water storage and also immigrant Bird resorts (middle October until late December), fish and other organisms in the lake; so due to restrictions on applying some controlling methods (such as using herbicides, reducing the level and dredging), cutting of procedure were evaluated for weed management in lake. Evaluating one time cutting and twice cutting on growth and regrowth of two dominate aquatic weed, C.vulgaris, and *N.felexilis* in Azadegan lake.

2. Materials and methods

This experiment performed in Azadegan Park's Lake located in district 15 Municipality south of Tehran in the summer of 2009. Experiments included cutting off in three levels of without cutting, one time and twice [2]. For sampling 9 restrictions of the lake were selected with 1m2 area composed of both experimental plant and after measuring height cutting performed from near the crown by a sharp scissor [2]. Mean height of C.vulgaris and N.felexilis in control treatment was measured 80 and 85 cm respectively. Herbal parts after cutting, transferred to laboratory and oven (80^{o}C for 48 h) to measure dry weight. Cutting intervals (first and second cutting) considered 30 days [2]. Water temperature was 28±2 during the experiment. The main physio-chemical parameters were listed in Table 1.

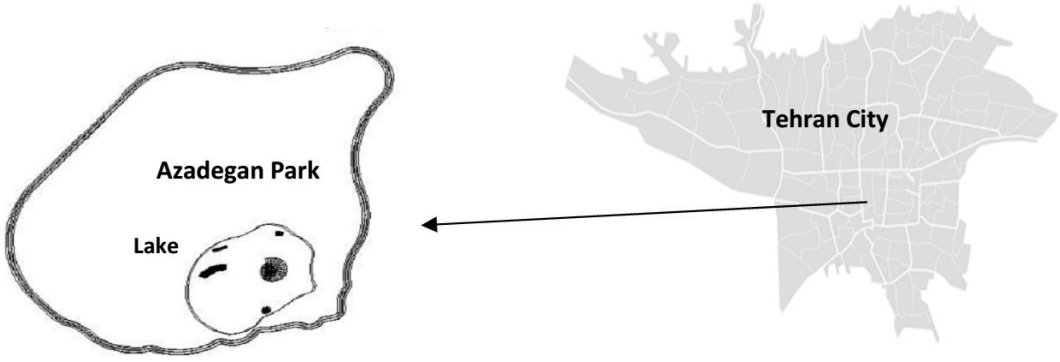

Figure 1. the schematic view of Azadegan lake.

Table 1. Measuring important parameters in the Lake

Test	Experimental result
Electrical conductivity µMhos/cm	1295
pH	8.32
Dissolved oxygen mg/l	11
BOD5 mg/l	5
COD mg/l	11
Ammonia mg/l	0.43
Nitrate mg/l	14.59

This experiment carried out in a completely randomized design with three replications [2,5,8]. Then height and dry weight of each treatment compared with control. Experimental plants were evaluated four weeks after final cutting in order to cut yield assessment.

Data analysis implemented by variance analysis and means comparisons performed by L.S.D procedure in 5% probability with Mstatc software. Pearson correlation test used for traits with SPSS software and figures depicted by Excel.

3. Results and Discussion

Variance analysis of experimental results from cutting effect on weed height and dry weight of C.vulgaris and N.felexilis showed that cutting off reduced both species height significantly (P≤ 0.01). One and two-time cutting also demonstrated the significant effects (P≤ 0.05) on experimental plants dry weight; as two times cutting resulted in more dry weight reduction than one time.

Table 2: results obtained by variance analysis of cutting effects on the given trait in Chara

cv	df	Mean square				
		Dry weight 1 (g)	Height after 30 days of firstly cutting (cm)	Dry weight 3 (g)	Height after 30 days of second cutting (cm)	Dry weight 3 (g)
R	2	3255.010 ns	0.667*	2164.860ns	4.167 ns	2164.860 ns
Cutting	2	32496.782ns	661.167*	16857.99ns	1263.5 **	16857.99*
Weed*cutting	1	1587.288 ns	7.214ns	754.133	3.571*	754.133*
error	2	1601.095	17.167	1143.087	36.167	1143.087

** represented significant differences in 0.01 level, * represented significant differences in 0.05 level, ns showed non-significant differences and first and second showed the cutting time

Table 3: results obtained by variance analysis of cutting effects on the given trait in Najas

cv	df	Mean square				
		Dry weight 1 (g)	Height after 30 days of firstly cutting (cm)	Dry weight 3 (g)	Height after 30 days of second cutting (cm)	Dry weight 3 (g)
R	2	153.520 ns	6.00*	70.727ns	121.500ns	70.727 ns
Cutting	2	23828.223ns	393.167*	15302.518ns	822.167ns	15302.518*
Weed*cutting	1	171.753 ns	0.997ns	328.878	170.185**	328.878ns
error	2	2856.508	3.500	3913.479	141.500	3913.479

** represented significant differences in 0.01 level, * represented significant differences in 0.05 level, ns showed non-significant differences and first and second showed the cutting time

According to obtained data for experimented plant height in control treatment (without cutting), *Chara* height in one time and twice cutting reduced 43.75 and 68.75 % respectively, rather than the control treatment.

Najas height was also reduced 13.8 and 44.4 % in one time and twice cutting respectively in comparison with control. Figures obtained by L.S.D test results proved significant effects (P≤0.05) of cutting on experimental plant height.

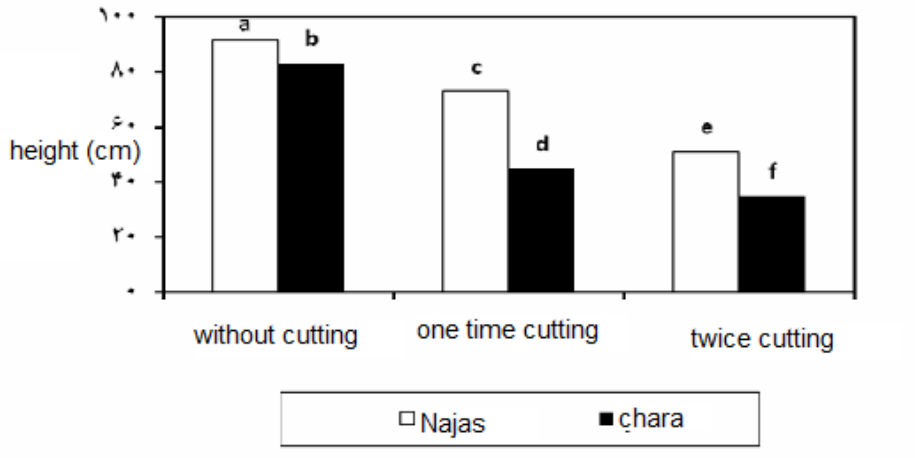

Figure 1: the effect of cutting on experimental species height.

Different letters show significant differences and the same letters shows non-significant differences.

Results of cutting effects on dry weight revealed its significant effects (P≤0.05) on reducing dry weight in comparison with control treatment.

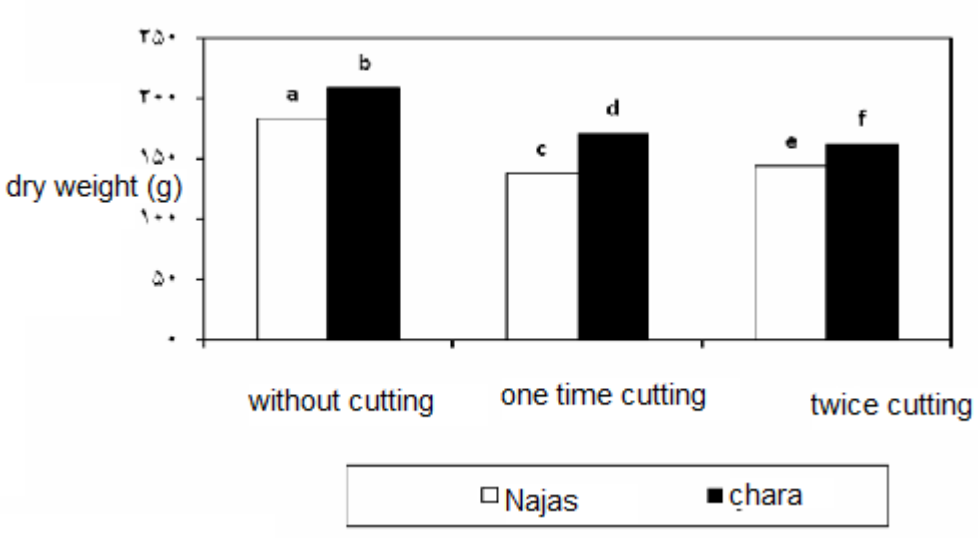

Figure 2. The effect of cutting on experimental plant dry weight.

Evaluating Pearson correlation coefficient showed that: there is a negative and significant correlation between plant dry weight and height in one time cutting treatment in 5% level and twice cutting had positive and significant correlation (P≤0.01).

Table 4: CO Pearson correlation coefficient between height and dry weight

	Dry weight 1	Height after 30 days of the first cutting	Dry weight 2	Height after 30 days of the second cutting
Height after 30 days of the first cutting	-0.211**			
Dry weight 2	0.356*	-0.341*		
Height after 30 days of second cutting	-0.736**	0.939**	-0.531*	
Total dry weight	-0.662**	0.782**	-0.51**	0.86**

** represented significant differences in 0.01 level, * represented significant differences in 0.05 level, ns showed non-significant differences

Results of this study with findings of Gunkel et al (1998), Hawea et al (2003) and Filizadeh et al (2002) showed that cutting repetition with definite intervals resulted in effective control on immersed weed due to eliminating photosynthetic tissues and reducing carbohydrate storage (leaves) and growth capability [2,5,9]. Observations from four weeks after final cutting conformed researches of Perkins et al., (1987) and Unmuth et al (1998) and showed that increasing nutrient availability in company with quiet condition of pound prepare the best growth condition of immersed aquatic species and reach to the highest vegetation growth capacity [3]; which results increasing regrowth strength and unsuccessful desired control ways implemented in this environment. So this study supported results presented by Hawes et al (2003), NI (2001) and Robertts et al (2001) which showed that however cutting reduced growth rate and exclusion significant amount of weed biomass than control treatment; because of favorable condition (like phosphorus [5,10,11], nitrogen, Calcareous beds and light penetration) in this lake one time cutting don't control weeds sufficiently and thoroughly. Then according to Grim (1979) growth strategy classification and one-time cutting results, C.vulgaris and N.felexilis is destructive type; means that in some treatments (15%) one-time cutting induced vegetation growth.

This study is confirmed by results obtained by Grime (1979), Gunkel et al (1998) and Filizadeh et al (2002), and emphasize on repeated periodically cutting and integration with other control strategies (such as shading or lower herbicide concentration) according to restrictions of the lake to effective and long term control. Pearson correlation results according to Grime strategy [12] (Grime, 1979) showed lowering height due to stress induced by cutting and changing plants strategy in short branch generation and increase dry weight in some treatments (15%) after one-time cutting. Correlation results of traits in

accordance with Filizadeh et al (2002) showed that twice cutting produced plant with a shorter height and low dry weight (positive correlation) in aquatic weeds [2].

Then regarding to the obtained results, we can suggest to design experiments to integrate cutting with other compatible control methods with environments such as introducing floating aquatic plant species (as Lotus) to reduce light penetration or releasing natural predators (like Amour fish) with control to effective and sustainable management of immersed weeds in the lake.

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