

Full Length Research Paper

Performance evaluation of *Typha latifolia* under the harsh conditions of Kuwait

***Habibah S. Al-Menaie, Ouhoud Al-Ragam, Majid Al-Zalzaleh, Meena Mathew and Nisha Suresh**

Arid land Agriculture and Greenery Department, Kuwait Institute for Scientific Research

Abstract

Growth performance of Cattail (*Typha latifolia*) procured from China was studied under the environmental conditions of Kuwait. The design of the experiment was Completely Randomized Design (CRD) with three replications. Rhizomes were planted in one-gallon containers filled with a growing medium comprising of sand and sphagnum peat moss (2:1 v/v) and placed in pond compartments filled with fresh water. Data on plant height and number of leaves were statistically analyzed using the statistical software R method. Results revealed that although cattail is an introduced plant species, it was performed well under the studied environmental conditions. The effect of water quality on the growth of cattail was studied using three different water sources i.e., fresh, brackish, and treated wastewater which were replicated thrice. Results showed that cattail can be grown well in any type of water regardless of the quality. The study on the effect of pot size on cattail growth and multiplication using pots of three different sizes pots i.e., 29h-30w-29d cm (circular), 50h-45w-22d cm (rectangular) and 22h-22w-13d cm (baskets) revealed that cattail performed better in rectangular pots than in circular pots or baskets and a higher number of seedlings was produced in rectangular pots.

Keywords: *Typha latifolia*, Growth Performance, Water Quality, Pot Size.

INTRODUCTION

Water gardens are becoming one of the most popular features in landscape projects and they are a wonderful way to enjoy the natural beauty of water plants. For the selection of plants for use in water gardens, factors such as water depth, amount of sunlight and how each species relates to the surroundings must be taken into account. The State of Kuwait is characterized by its adverse climatic and environmental conditions like extreme temperatures, low soil fertility and scarce water resources FAO (2004). Consequently, only hardy and salt-tolerant species can be grown successfully for greenery purposes.

It has become very important to investigate in such a way, which can help to augment the greenery and landscape development in Kuwait without depending on fertile soils. Water gardening can be used to complement the regular terrestrial gardens to increase the green surface in landscape projects. Moreover, introduction of water plants to the urban landscape can be helpful to enhance the aesthetic value.

Even though water plants are suitable for a wide variety of climates including the desert climate, it is now becoming an essential study to the development of water gardens in Kuwait. Among the water plants, Cattails are one of the valuable aquatic ornamental plants with a flowering spike and flat blade like leaves. They are among the most common of all aquatic and wetland plants anywhere. Since cattails can quickly spread and cover entire planting areas, it can be exploited in urban landscapes for aquascaping and

*Corresponding Author E-mail: hmanaie@safat.kisr.edu.kw;
Tel: (+965) 24989806

restoration projects. *Typha latifolia* can play a major role in restoration of an agricultural landscape (Wild et al., 2001; Newman et al., 1996; Coveney et al., 2002). Common cattail can be used as a good candidate for incorporation into a phytoremediation scheme for removing metalaxyl and simazine residues from contaminated water (Wilson et al., 2000). *Typha* species are also considered as invasive weeds in wetlands (Shih and Finkelstein, 2008). According to Morteau et al., (2009) *Typha latifolia* can be incorporated in constructed wetlands to treat salted road runoffs before they reached natural ecosystems.

A reliable source of high quality water is essential for a water garden and since water plants live in water, the major environmental concern within the culture system is water quality. According to Boyd and Tucker (1998) water quality is the summation of all physical, chemical, biological, and aesthetic characteristics of water that influence its beneficial use. The irrigation water source can affect the water quality which is determined by measuring the level of dissolved elements (Whipker, 1999). Like in several other arid and semiarid countries, freshwater resources are scarce and are very expensive. Because of high costs of desalination and delivery of freshwater supplies to agricultural areas, farmers mainly rely on the use of brackish water for irrigation. Hence, a study on the effect of low-quality water on the performance of Cattail is very essential. Since tertiary treated wastewater is as good as drinking water, its effect on water-plant growth was also studied so that it can be used for water gardening in the future.

For growing water plants, the effect of pot size is very important. Pot size may affect root and shoot growth, biomass accumulation and partitioning, photosynthesis, leaf-chlorophyll content, plant water relations, nutrient uptake, respiration, and flowering (NeSmith and Duval, 1998; Cantliffe (1993)). According to Keever et al., (1985), growth of ornamental plants depends on pot size. Findings from the activity FA005G (Al-Menaie and Al-Zalzaleh, 2000) proved that water plants planted directly at the bottom of the pond do not grow well and that water plants grow better when planted in pots which are then be placed at the bottom of the pond. Hence, determination of pot size is important for successful planting of water plants in artificial ponds.

Hence During this research work, studies were conducted to evaluate the performance of cattails, to determine the effect of water quality on the growth of cattail and to determine the effect of pot size on plant growth and multiplication under the desert conditions of Kuwait.

MATERIALS AND METHODS

The study was conducted at the Urban Demonstration Garden Site (UDG) of Kuwait Institute for Scientific

Research (KISR), Kuwait as an enduring attempt to test the viability of establishing a domestic production base for cattails. Variety *Typha latifolia* which belongs to the family Typhaceae was selected and imported after scientific appraisal of various plant morphological characteristics from Shanghai Xinhai Cultivation of Flowers Co., Ltd, China. The planting materials were covered with a mixture of sphagnum peat moss and perlite to retain moisture, and were labeled separately along with source information before transport. The plants were imported via airmail to KISR after taking all the required quarantine measures to avoid any seed borne diseases from entering into Kuwait. Immediately after arrival at KISR, the materials were removed from the moist packaging materials, cleaned well and stored temporarily in plastic trays and buckets filled with water. Immediately upon arrival at KISR, they were closely inspected for any pest or disease infestation and then immersed in 1% solution of potassium permanganate (KMnO_4) for 10 minutes, and subsequently rinsed with cold water.

Three replicates of cattail (*Typha latifolia*) were tested in a Completely Randomized Design. One gallon containers were filled with a growing medium comprising of sand and sphagnum peat moss in 2:1 (v/v) which was thoroughly soaked for compacting. The plants were placed at the center of the container and covered with the growing medium with the crown of the plant at soil level. Care was taken to bury the rhizome not too deep in the soil. The top portion of the containers was filled with one inch of sand to prevent the top soil from discoloring the pond water. The containers were then placed in the pond compartments filled with fresh water. Once the plants were established, aquatic fertilizer tablets were inserted in the growing medium about two inches from the rhizome. No incidences of pests or diseases were detected during the assessment period.

To study the effect of water quality on the growth of cattails, three plant replicates were tested using different water sources i.e., fresh, brackish and treated waste water. For these water sources, it has used three water tanks in this experiment. The rate of growth was measured on a monthly basis for the plant height and number of leaves.

Before the experiment, water samples were taken and sent for analysis and the results are showed in Table 1. Since the water in the tanks can be effectively utilized for irrigating the terrestrial plants in the waterfront site, the outlet valves were connected to the main irrigation system thereby preventing the wastage of water. Changing of water at regular intervals prevented dust accumulation and no chemicals were added for the control of insect pests and algae. To determine the effect of pot size, three different sized pots namely i.e., 29h-30w-29d cm (circular), 50h-45w-22d cm (rectangular) and 22h-22w-13d cm (baskets) were selected and the plants were inserted.

Table 1. Properties of Water Samples

Water Type	pH	ECe mS/cm	Cations (meq/l)				Anions (meq/l)		
			Ca ⁺²	Mg ⁺²	Na ⁺	K ⁺	CO ₃ ⁻	HCO ₃ ⁻	Cl ⁻
Fresh Water	7.1	0.476	1.83	0.85	2.61	0.10	<0.01	0.94	2.02
Brackish Water	6.8	4.94	17.53	12.45	34.78	0.48	<0.01	1.44	32.07
Treated Wastewater	6.9	5.11	18.50	12.03	34.78	0.48	<0.01	1.44	34.06

ECe: Electrical Conductivity

Table 2. Temperature and Day-Length Conditions during the Field Study

Month	Temperature(°C)			Day Length (h:min)
	Maximum	Minimum	Average	
2009				
July	45.9	31.1	39.0	9:28
August	46.5	31.0	38.4	8:25
September	42.7	27.3	34.7	9:29
October	37.5	21.6	28.9	7:32
November	26.0	15.0	21.0	8.03
December	20.0	9.00	14.5	7.0
2010				
January	17.87	16.86	17.37	8.02
February	19.33	18.13	18.73	8.91
March	24.31	22.87	23.59	9.05
April	28.42	26.95	27.69	9.55
May	33.02	31.39	32.21	10.13
June	37.36	35.52	36.44	10.51
July	38.35	36.63	37.49	10.92
August	40.12	38.22	39.17	11.31
September	36.40	34.71	35.56	10.32

Kuwait climatological data during the period of study are detailed in Table 2. The average maximum day time temperature at the time the cattails were received in Kuwait was 48.5°C. During the study period, the average maximum daytime temperatures varied between 46.5°C in August 2009 and 40.12°C in August 2010. The average minimum daytime temperature was recorded during December 2009 (9°C). The periodic data on plant height and number of leaves were measured on monthly basis to evaluate the growth performance of cattail under the environmental conditions of Kuwait, to determine the effect of water quality on plant growth and to determine the effect of pot size on cattail growth and statistically

analyzed using the software R followed by Crowley, (2005).

RESULTS AND DISCUSSION

The analysis provided a clear picture of growth performance of Cattail *Typha latifolia* under arid conditions (Figures 1 and 2). Even though Cattail (*Typha latifolia* L.) is an introduced plant, it performed well under Kuwait's environmental conditions (Plate 1). It is tolerant to varying climatic conditions and environmental changes (Murkin and Ward, 1980) and is sometimes considered an invasive native in aquatic communities. It

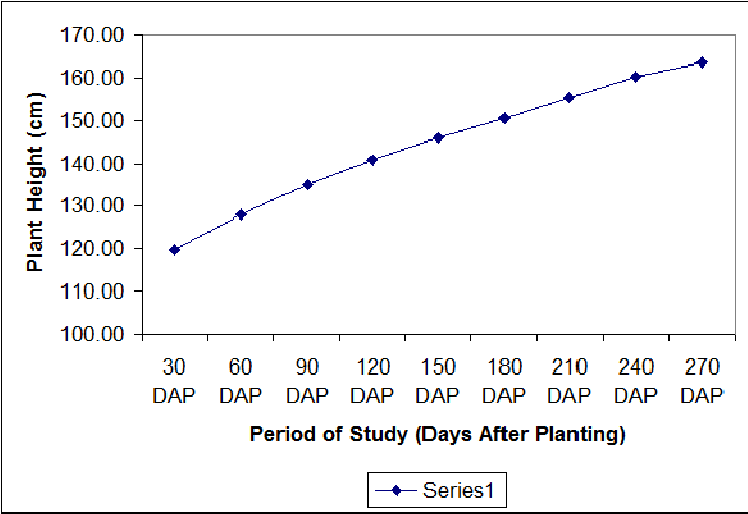


Figure 1. Average Height of Plants Produced for Cattail (*Typha latifolia*) under the Experiment Performance Evaluation of Cattails.

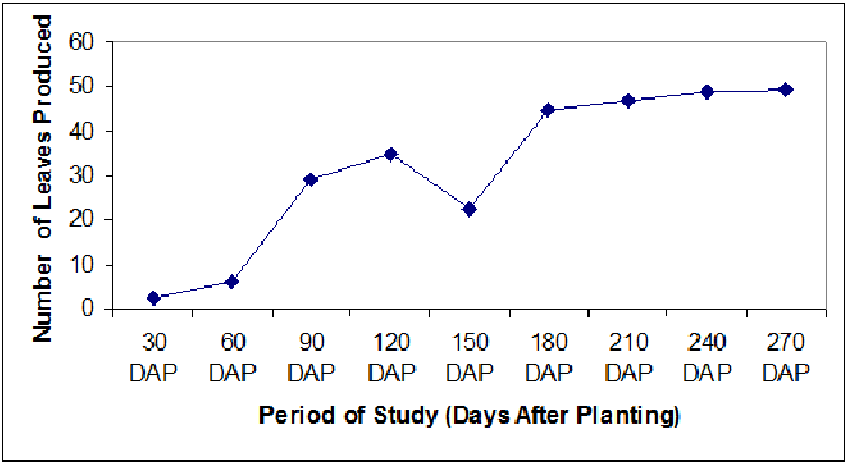


Figure 2. Average Number of Leaves Produced for Cattail (*Typha latifolia*) under the Experiment Performance Evaluation of Cattails.



Plate 1. Profuse growth of *Typha latifolia* during the study period.



Plate 2. *Typha latifolia* growing in brackish water .

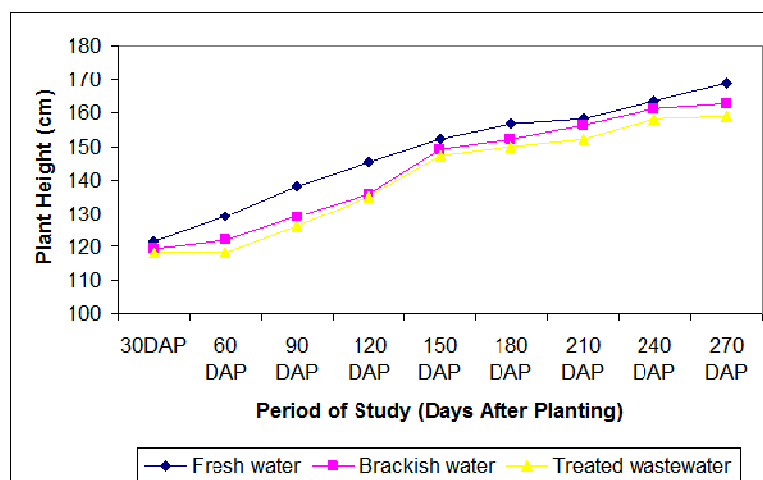


Figure 3. Average Plant Height Produced under Different Water Treatments

was found to be a very fast growing plant, attaining a plant height of 163.67 cm and average numbers of leaves of 49.33 at 270 DAP. This perennial aquatic herb with its tall, sword-shaped leaves and distinctive fruiting spikes can complement greenery development projects in Kuwait (Plate 1). But care must be taken so that the plant will not become invasive.

Figures 3 and 4 showed that *Typha* can grow well in any type of water regardless of the quality. Statistical analysis revealed that the treatments were nonsignificant. Observations recorded on the number of leaves and average plant height showed that the treatments were not affected by the water quality. Since they are tolerant to varying climatic conditions, environmental changes, and water qualities they can dominate in aquatic plant communities (Mitch, 2000). In addition, cattails' have flat green leaves along with

overtopping flowering spikes which can complement the landscape beautification designs in Kuwait. According to Baldwin and Canon (2007), Cattail is having a tendency to dominate in aquatic communities, hence proper management strategies and care must be taken to prevent the plant from becoming invasive in landscaping projects.

Results of the study on the effect of pot size on cattail growth are detailed in Figures 5 and 6, The numbers of leaves produced were significantly different among the different treatments during the study period except at 30 DAP. From the results it was clear that plants grew well in rectangular pots than the other two types of pots. At 180 DAP, plants grown in circular pots, rectangular pots, and baskets recorded values of 68.00, 87.00, and 62.89 respectively. Regarding plant height, at 180 DAP, plants grown in rectangular pots recorded a

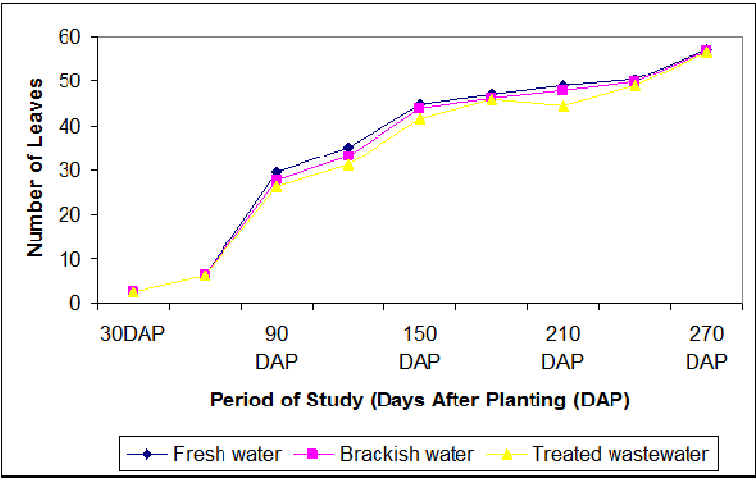


Figure 4. Average Number of Leaves Produced under Different Water Treatments

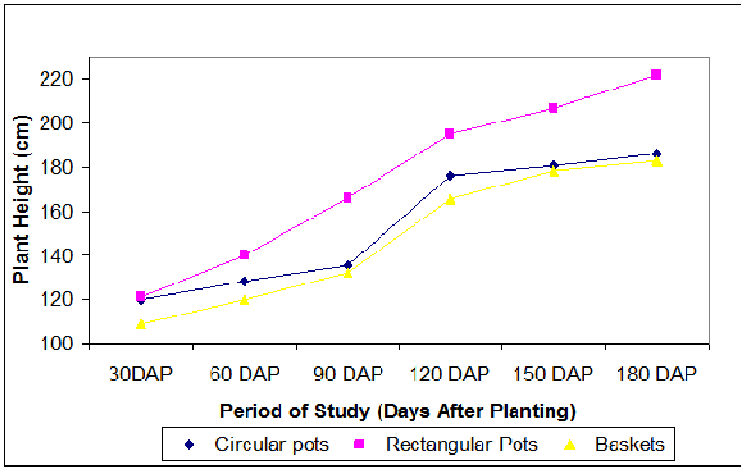


Figure 5. *Typha latifolia*: Average Plant Height (cm) of Plants Produced in Different Pot Sizes

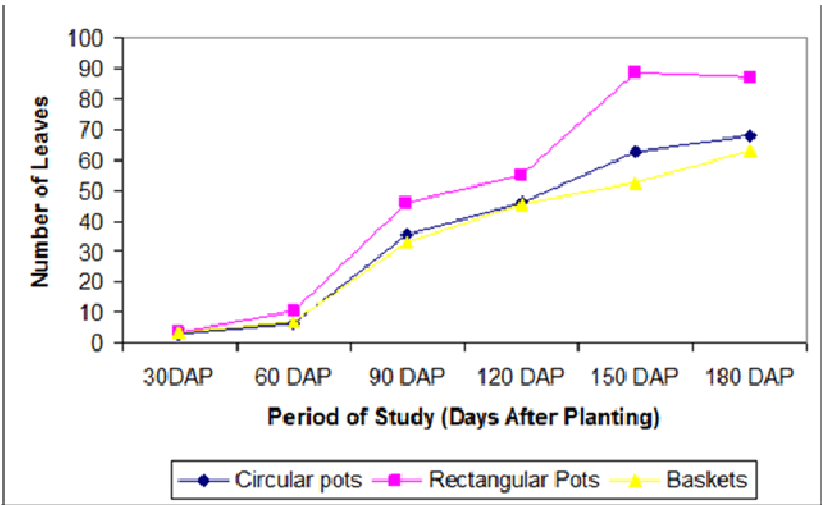


Figure 6. *Typha latifolia*: Average Number of Leaves Produced in Different Pot Sizes

petiole length of 221.87 cm whereas the values for plants grown in circular pots and baskets were 186.35 and 182.89 cm, respectively. From statistical analysis it was clear that the treatments were significantly different except at 30 DAP.

Cattail performed better in rectangular pots than in circular pots or baskets and a higher number of seedlings was produced in rectangular pots. This could be due to the increased plant-leaf area, shoot biomass and root biomass in rectangular pots compared to circular pots and baskets. This is in conformity with the findings of Cantliffe (1993). According to Audet and Charest (2010), pot size influences the dynamics of resource allocation which influences plant growth. The effect of container size and root restriction for growth has been documented for marigold (Latimer, 1991). When the container size was reduced, the rooting volume decreased leading to a reduction in plant growth. Plant growth was stunted even for the best performing plants, due to the small pot size (Ursine, 2008).

CONCLUSION

Results from the trial indicated that Cattail performs well and have good potential for growth and adaptability to the climatic conditions of Kuwait. The study on the effect of water quality on the growth of Cattail showed that it can be grown well in any type of water regardless of the quality and hence successful water gardening using cattails in Kuwait is possible using the available source of water. Also it performed better in rectangular pots than in circular pots or baskets and a higher number of seedlings was produced in rectangular pots which could be due to the increased plant-leaf area, shoot biomass and root biomass in rectangular pots compared to circular pots and baskets.

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