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SURVEYING THE GROWTH AND WASTEWATER TREATMENT ABILITY OF PARA GRASS (BRACHIARIA MUTICA) VEGETATION IN THE STABILIZATION PONDS

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ABSTRACT

The use of aquatic plants to treat wastewater is an environmentally friendly solution. In this study, Para grass (Brachiaria Mutica) is grownin a water stabilization pond. Studying the growth cycle of Para grass for 35 days showed that the grass grew relatively fast in the first 20 days, but starting from day 20 - 21 the grass started to blossom and grew more slowly. Para grassgrew equally in the first 12 days in both rainy and dry seasons. However, Para grass grows in the rainy season is better than in the dry season in the next 12 days. In the 24 - day cycle, 1m^2 of dry grass contain the highest yield of 174.6g of carbohydrate, 18.97g of nitrogen and 2.85g of phosphorus. The stabilization pond which is covered by Para grass treated wastewater well. When the flow rate is reduced to 0, 25 m^3/h, this system is capable of handling pollutants such as COD; total N, total P which is better than 0, 35 m^3/h. Para grass is capable of growing rapidly, unregenerate. Para grass is also more suitable than water spinach and water hyacinth because these plants have a rotting cycle that causes secondary water pollution. This research direction is suitable for the current sustainable development trend: using the method with low cost, friendly to the environment, easy to operate and use plant species which are available in Vietnam.

Keywords: para grass, stabilization pond, sustainable development, wastewater treatment, undegenerate, environmentally friendly.

1. INTRODUCTION

Para grass is a perennial grass [1]. Stems may reach 3 feet (1 m) in erecting or 15 feet (3m) in creeping [2]. Stems are hollow and robust. The stems have hairy nodes and leaf sheaths. Its roots sprout new roots wherever the nodes touch the ground. Para grass is leafy. Leaf blades are hairy, up to 30 cm long and 16 - 20 mm wide [3]. Inflorescences are terminal panicles up to 8 inches (20 cm) long, with 8 to 20 ascending, alternate branches. Spikelets are dense, paired, and approximately 3 mm long [2]. Para grass can grow in flooded conditions: its hairy leaves and hollow stems float over water depths from 0.3 m to 1.2 m depending on water temperature (deeper in warmer water). Para grass can grow in moist soils of humid and sub-humid areas with annual rainfall of 1200-4000 mm, or in swampy areas of drier environments down to 900 mm rainfall [3]. Para grass is a warm climate grass that grows effectively at temperatures around 22°C and stops growing under 15°C. Though para grass prefers alluvial and hydromorphic soils, it does well on a wide range of soils: from sands to clays with moderate to good fertility [3, 4]. This study aims to survey the growth and wastewater treatment ability of Para grass (Brachiaria Mutica) in industrial wastewater environment.

2. MATERIALS AND METHODS

Constructing a water stabilization pond which has the size is: L x W x H= (4,0 m x 2,0 m x 4,0 m) and the surface of the pond is covered by Para grass. Wastewateris distributed to one side of the ponds, operate continuously 24 hours per day (Figure-2). Experimental vegetation is Para grass which is planted on the lake surface, with initial coverage area for 50 percent. Para grass starts growing by the nutrients presenting in wastewater after about 2 days (Figure-3).

Figure-1. Para grass (Brachiaria Mutica).

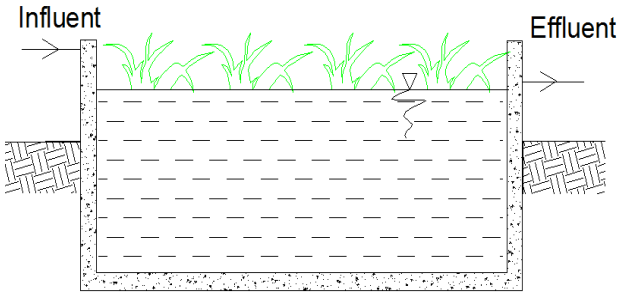

Figure-2. Model of wastewater treatment by facultative waste stabilization pond covered with Para grass on the pilot scale.

Figure-3. Part view of facultative waste stabilization pond covered with Para grass.

3. RESULTS AND DISCUSSIONS

3.1 The height and spread of Para Grass

Studying the growth cycle of Para grass for 35 days showed that the grass grew relatively fast in the first 20 days, but starting from day 20 - 21 the grass started to blossom and grew more slowly (Figure-4). Therefore, to improve the growth of grass and increase the efficiency of wastewater treatment, it is necessary to cut grass periodically between 23-25 days.

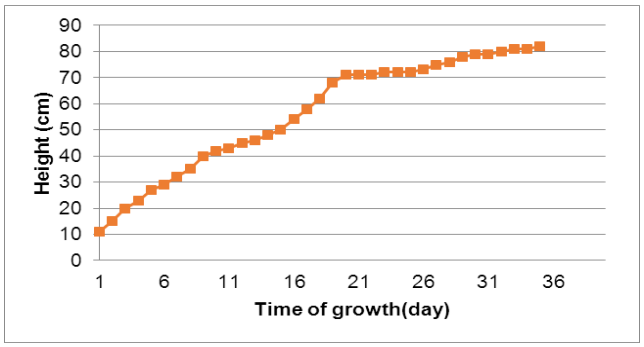

Figure-4. The growth curve for the height of Para grass.

Southern of Vietnam normally has 2 typical seasons: rainy and dry. Rainy season from May to November and a dry season from December to April next year. This study also examines the growth of Para grass according to the season. The results show that Para grassgrew equally in the first 12 days in both rainy and dry seasons. However, Para grass grows in the rainy season is better than in the dry season in the next 12 days (Figure-5).

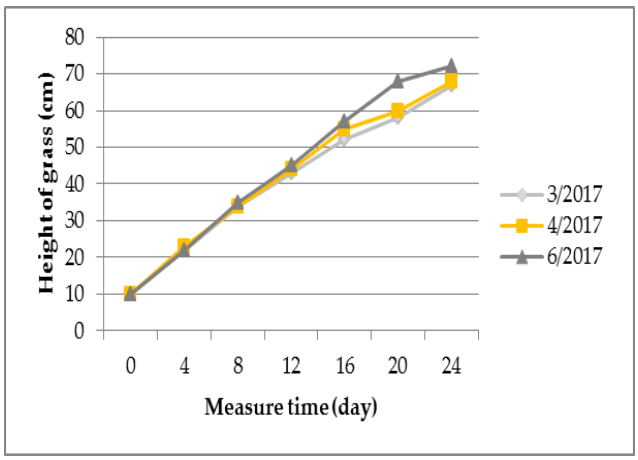

Figure-5. Growth in the height of Para Grass in rainy and dry season (The first-day height corresponds to the height of the remaining stem after cutting to new litter).

A 24 - day survey showed that the Para grass grows rapidly and can reach 180cm spread after 24 days (Figure-6). Therefore, Para grass can form floating rafts on the lake and not degenerate, capable of high recovery after cutting.

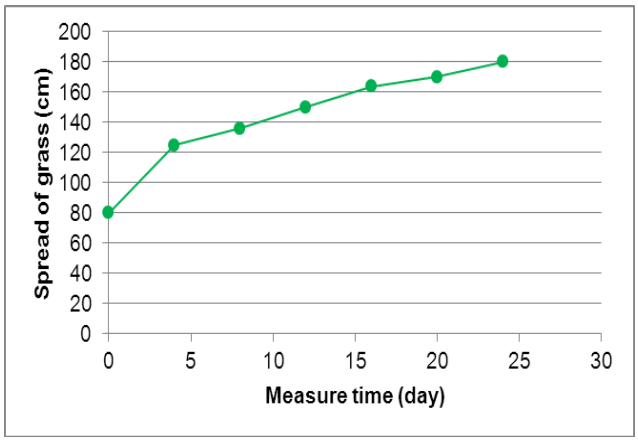

Figure-6. Horizontal growth of Para.

3.2 The biomass of Para Grass

Analysis of grass biomass on the 24th day of the survey in both rainy and dry seasons showed that the weight of grass collected per 1 m^2 also varies between dry and rainy seasons (Figure-7). The analysis results show that there are 2.58g N, 0.37g P and 24.7g Carbohydrate in 100g of dry grass. In the 24 - day cycle, 1m^2 of dry grass contain the highest yield of 174.6g of carbohydrate, 18.97g of nitrogen and 2.85g of phosphorus. From this result, it can prove that Para grass can absorb and

accumulate nutrients in wastewater to grow and increase biomass.

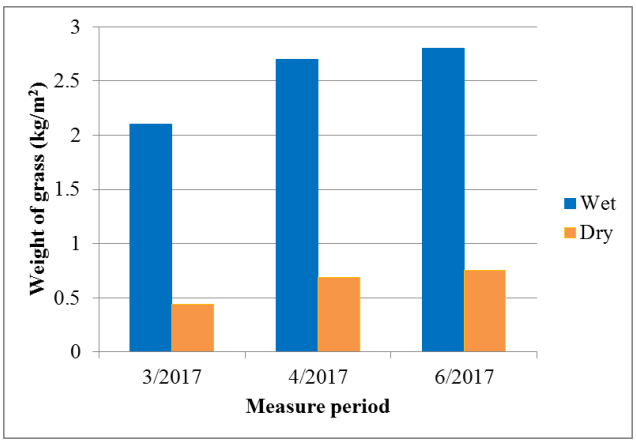

Figure-7. Biomass of Para grass in rainy and dry season (Harvested on the 24th of the survey).

3.3 Advantages of Para grass compared to other aquatic plants

The use of water hyacinth *in* wastewater treatment systems has been considered. However, decomposition of the water hyacinth was rapid. Time to 50% decomposition of whole plants, leaves, and roots was 21, 31 and 45 days, respectively [8]. While Para grass is highly recoverable after periodic cutting, create floating raft for stabilization pond, so it does not pollute secondary water such as water hyacinth.

3.4 Surveying effect of inlet flow on wastewater treatment efficiency of Para grass's pond

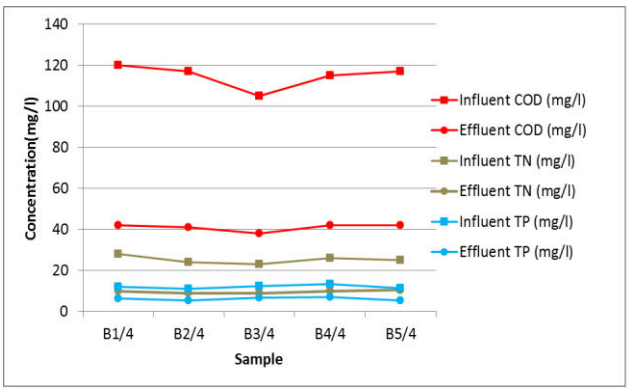

Figure-8. Wastewater treatment results of influent flow rate are 0, 25 m^3/h.

In order to assess the effect of the retention time on the pollutant removal efficiency of the *Brachiaria mutica* pond, the study conducted to change the inflow's flow rate with 2 values is 0.25 m^3/h (corresponding to retention time of 5.3 days) (Table-1 and Figure-9) and 0.35 m^3/h, (corresponding to the retention time of 3.8 days) (Table-2 and Figure-10).

The results of wastewater treatment with the flow of 0, 25 m^3/h and 0, 35 m^3/h showed that the stabilization pond which is covered by Para grass treated wastewater well. In addition, when the flow rate is reduced to 0, 25 m^3/h, this system is capable of handling pollutants such as COD, total N, total P which is better than 0, 35 m^3/h. The results of the survey show that the *mechanism* of organic matter, phosphorus, and nitrogen removal in wastewater of Para grass is probably due to the ability to directly absorb N, P in wastewater as a source of nutrients, in part due to the process nitrification with the presence of bacteria will convert NO_3^- into N_2.In addition, organic pollutants can be partially absorbed by the roots and partially transformed into CO_2 and H_2O with the presence of microorganisms in the root system. The root system has a role as a substrate for active microorganisms (Figure-11).

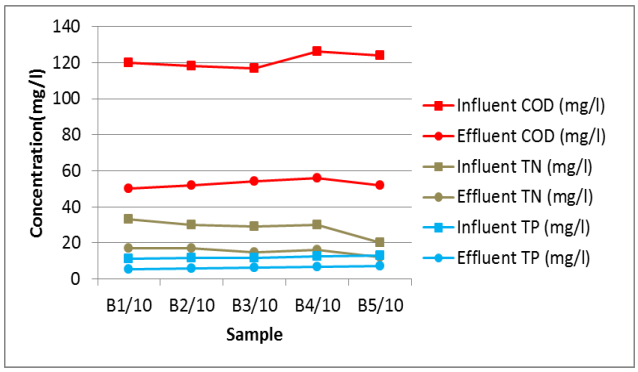

Figure-9. Wastewater treatment results of influent flow rate are 0, 35 m^3/h.

The results explain this mechanism by the study by Linda L. Handley *et al.* [9]. In 1981, they used Para grass to remove nitrogen from domestic wastewater. Under irrigation rates as high as 98 mm/day, five days/week, evapotranspiration averaged 4.6 mm/day.

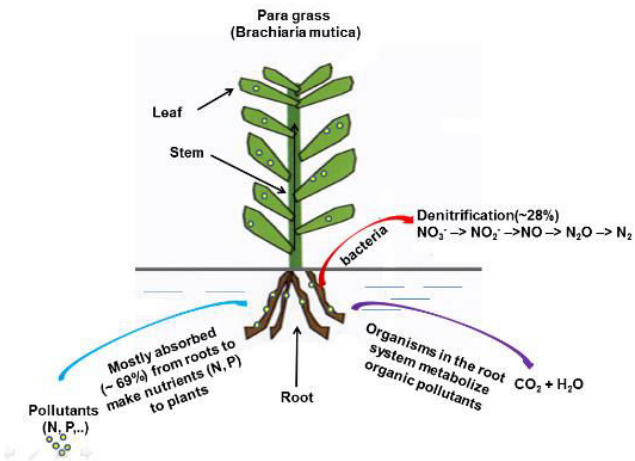

Figure-10. Pollution treatment mechanism of Para grass.

With nitrogen applications of 130 to 2,600 kg/ha/yr, ≥ 69 percent of applied nitrogen was harvested in the grass; 3 percent percolated, and ≤ 28 percent was denitrified. With the highest effluent irrigation rates,

nitrate-nitrogen levels remained below the 10 mg/L maximum recommended for potable water.

Table-1. Wastewater treatment results of influent flow rate are 0, 25 m^3/h (corresponding to the retention time of 5.3days).

Sample	Time	COD (mg/l)		Total N (mg/l)		Total P (mg/l)		pH	
		Inf	Eff	Inf	Eff	Inf	Eff	Inf	Eff
B1/4	1	120± 1,3	42± 0,8	28± 0,3	10± 0,12	12± 0,13	6,3± 0,07	7,54± 0,07	7,32± 0,1
B2/4	2	117± 1,2	41± 0,6	24± 0,3	9± 0,13	11± 0,12	5,4± 0,07	7,40± 0,08	6,78± 0,08
B3/4	3	105± 1,1	38± 0,5	23± 0,5	9± 0,1	12,5± 0,14	6,7± 0,08	7,40± 0,06	7,02± 0,09
B4/4	4	115± 1	42± 0,8	26± 0,4	10± 0,13	13,5± 0,15	7,1± 0,09	7,38± 0,09	7,36± 0,07
B5/4	5	117± 1,2	42± 0,6	25± 0,3	10,5± 0,15	11,5± 0,13	5,4± 0,07	7,46± 0,1	7,13± 0,09

*Note: Average value of 3 trials ± Standard Devision

Table-2. Wastewater treatment results of influent flow rate are 0, 35 m^3/h(corresponding to the retention time of 3.8 days).

Sample	Time	COD (mg/l)		Total nitrogem (mg/l)		Total phosphorus (mg/l)		pH	
		Inf	Eff	Inf	Eff	Inf	Eff	Inf	Eff
B1/10	1	120± 1,2	50± 0,7	33± 0,4	17± 0,2	11,1± 0,1	5,6± 0,07	7,67± 0,09	7,32± 0,07
B2/10	2	118± 1,3	52± 0,6	30± 0,3	17± 0,3	11,5± 0,2	6,0± 0,05	7,56 ± 0,1	7,05± 0,08
B3/10	3	117± 1,2	54± 0,9	29± 0,4	15± 0,2	11,9± 0,2	6,2± 0,06	7,34± 0,07	7,03± 0,07
B4/10	4	126± 1,4	56± 0,6	30± 0,5	16± 0,2	12,5± 0,1	6,7± 0,05	7,43± 0,08	6,84± 0,1
B5/10	5	124± 1,3	52± 0,9	20± 0,2	12± 0,1	12,9± 0,3	7,2± 0,07	7,08 ± 0,1	6,70± 0,1

*Note: Average value of 3 trials ± Standard Devision

4. CONCLUSIONS

The results show that Para grass is capable of growing rapidly during the year under the condition of southern weather, undegenerate, which can create floating raft for stabilization pond. Experimental results show that stabilization covered the Para grass is only processed over a periodbut the wastewater treatment effect is quite high. Para grass is also more suitable than water spinach and water hyacinth because these plants have a rotting cycle that causes secondary water pollution. Moreover, this is a research direction that is suitable with the current sustainable development trend: using method with low cost, friendly to the environment, easy to operate and use plant species which are available in Vietnam.

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