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Nitrogen and Phosphorus Treatment from Dormitory Wastewater of Srinakharinwirot University Ongkaruk by Acrostichumaureum L. and Eucalyptus globulus Labill.

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***Abstract*—Contaminated nutrients in wastewater is critical problem of worldwide. The aim of this study was nitrogen and phosphorus treatment from dormitory wastewater of Srinakharinwirot University Ongkaruk by *Acrostichumaureum* L. and *Eucalyptus globulus* Labill. The plants were cultured in the pot and treated wastewater for 4 cycles. The differed plant weight was compared the efficiency in nitrogen and phosphorus treatment. The result found that *Eucalyptus globulus* Labill which is perennial plant had better efficiency in nitrogen and phosphorus treatment than *Acrostichumaureum* L. which is aquatic plant. The plant could grow well in wastewater and removed nutrients until passed standard criteria for short time. Moreover, plant biomass increased after nitrogen and phosphorus treatment for one month. These results showed the sustainable system in nutrients treatment from wastewater. *Eucalyptus globulus* Labill is new selected plant to remove nutrients and suit to apply for nitrogen and phosphorus treatment from wastewater.**

***Keywords*—nitrogen, phosphorus, wastewater treatment, *Acrostichumaureum* L., *Eucalyptus globulus* Labill.**

I. Introduction

Excessive nitrogen and phosphorus in water bodies is a critical problem of worldwide. These nutrients contaminated in aquatic ecosystem result in eutrophication [1]. Nitrogen and phosphorus are discharged from municipal, agricultural and industrial effluent [2]. Nitrogen and phosphorus contaminated in several sources such as lakes, rivers, reservior, and coastal waters. Especially, the most of these nutrients is contaminated in domestic wastewater of Thailand [3]. Eutrophication induce to the toxic algal bloom, low oxygen and dead of aquatic animals [4]. There are many methods to remove nutrients from wastewater is physical and chemical methods. However, these method disadvantages are high cost of operation and low efficiency for nitrogen and phosphorus treatment. Therefore, phytoremediation is alternative method to remove these nutrients because of lower cost, easier to operate system, and environmentally friendly [5]. Moreover, nitrogen and phosphorus can be removed simultaneously by phytoremediation because plants adsorb these nutrients through roots available for their growth [6].

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There was several researches investigated plants efficiency in nitrogen and phosphorus treatment. X. Yu et al. [7] evaluated many species of plant was *Schoenoplectuslacustris*, *Vetiveriazizanioides*, *Acoruscalamus*, *Canna indica*, *Zizanialatifolia*, *Phragmites communis*, and *Iris pseudacorus* to remove nitrogen and phosphorus. C. Yan et al. [8] evaluated plants ability for nitrogen and phosphorus treatment, which was canna, iris, calla lily, dwarf papyrus, arrow arum, pickerelweed and bulltongue arrowhead.

Preliminary study investigated the efficiency of *Acrostichumaureum* L. to remove nitrogen and phosphorus from dormitory wastewater of university. *Acrostichumaureum* L., which is mangrove plant, had ability to remove nitrogen and phosphorus. The plant grew well in wastewater. Many researches studied aquatic plant to remove nitrogen and phosphorus. This study interested the perennial plant for nutrients treatment. The plant is *Eucalyptus globulus* Labill, which is no one, study to remove nutrients from wastewater. In addition, *Eucalyptus globulus* Labill is raw material to produce paper.

The aim of this study was comparison the efficiency of *Acrostichumaureum* L. and *Eucalyptus globulus* Labill in nitrogen and phosphorus treatment from dormitory wastewater of Srinakharinwirot University Ongkaruk. Sustainable system in nitrogen and phosphorus treatment was studied and plant biomass after nutrients treatment was also determined.

II. Materials and Methods

A. *Plant Preparation*

Acrostichumaureum L. and *Eucalyptus globulus* Labill. were prepared at 200 g and 400 g of fresh weight. Plants were cleaned and put in the pots that contained tap water for conditioning plants before using in the experiment. Then plants were used for nitrogen and phosphorus treatment at the greenhouse of Srinakharinwirot University Ongkaruk.

B. *Wastewater Preparation*

Wastewater was collected by composite sampling method from the effluent of Srinakharinwirot University Ongkaruk dormitory.

C. *Nitrogen and Phosphorus Treatment by Acrostichumaureum* L. *and Eucalyptus globulus* Labill.

The plants were cultures in pots (12 inches in diameter). In the experiment comprised of 200 g of plants + 100 g of soil + 3 liters of wastewater, 400 g of plants + 100 g of soil + 3 liters of wastewater, 100 g of soil + 3 liters of wastewater, and only 3 liters of wastewater. Then wastewater was collected at day 1, 3, 5, 7, 9, and 12 for determination nitrate nitrogen and phosphate concentrations by the cadmium reduction and the ascorbic acid colorimetric method, respectively [9].

D. *The Sustainability of the System in Nitrogen and Phosphorus Treatment by Acrostichumaureum* L. *and Eucalyptus globulus* Labill.

Nitrogen and phosphorus in the effluent of dormitory were treated by *Acrostichumaureum* L. and *Eucalyptus globulus* Labill for 4 cycles continuously. When ammonia-nitrogen and phosphate concentrations passed standard criteria of Pollution control department (0.5 mg L^{-1}) and USEPA (0.1 mg L^{-1}) [10], a new lot of wastewater was replaced in the system for study the sustainable treatment in the next cycle. Wastewater was sampled and determined ammonia-nitrogen, nitrate-nitrogen, and phosphate concentrations by the same method in section C.

E. *Biomass of Plants after Nitrogen and Phosphorus Treatment from Dormitory Wastewater for 4 Cycles*

Acrostichumaureum L. *and Eucalyptus globulus* Labill in the control and treatment systems were harvested after treatment for 4 cycles to determine the biomass. Then harvested plants were cleaned with distilled water and the fresh weight was recorded. After that the plant samples were oven dried at 65 °C to a constant weight. Then the plants were cooled in desiccators and the dry weight was measured [11].

III. Results and Discussion

A. *Phosphorus Treatment by Acrostichumaureum* L. *and Eucalyptus globulus* Labill.

Phosphorus treatment by *Acrostichumaureum* L. and *Eucalyptus globulus* Labill was studied for 4 cycles. The different plant weight was 200 g and 400 g of plants that were compared in phosphorus treatment. The result found that the system with plant was more efficiency phosphorus treatment than the system without plant. 200 g of *Eucalyptus globulus* Labill had better efficiency in phosphorus treatment than other systems. This result because the plant root characteristic is long and numerous. It can take up phosphorus in wastewater well. Phosphorus in wastewater promoted plant growth result in the plant grew well. Plant taken up phosphorus from wastewater in ortho-phosphate form available for their growth [12].

Phosphate concentration in the system with soil and wastewater was decreased. This result may be due to soil adsorption and microorganism role in wastewater [13]. Phosphate concentration was gradually decreased until passed standard criteria of USEPA (0.1 mg L^{-1}) within 2 days in all cycle of the system with *Eucalyptus globulus* Labill (Fig 1-4). The result showed sustainable system of phosphorus treatment by *Eucalyptus globulus* Labill. Although *Eucalyptus globulus* Labill is perennial plant, it could treat phosphorus continuously and be healthy in wastewater. Phosphate concentration of the system with 400 g *Eucalyptus globulus* Labill was increased. The result due to plant decay effected phosphate release in the system.

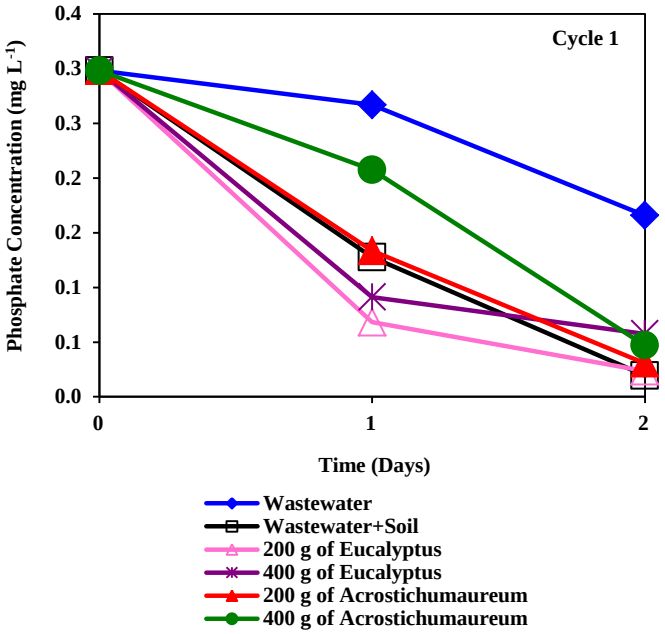

Figure 1. Phosphorus treatment by *Acrostichumaureum* L. and *Eucalyptus globulus* Labill in cycle 1

B. *Nitrogen Treatment by Acrostichumaureum* L. *and Eucalyptus globulus* Labill.

Nitrogen treatment by *Acrostichumaureum* L. and *Eucalyptus globulus* Labill was studied for 4 cycles. The result showed that nitrate-nitrogen in the system with plants was decreased (Fig 5-8). This result because plant taken up nitrogen from wastewater in nitrate form available for their growth [12]. However, nitrate-nitrogen in the system with soil and wastewater was decreased. This may be due to microorganism role in wastewater and soil or denitrification process [14]. The effect of nitrate-nitrogen decreased because of nitrification, denitrification, plant and microbial uptake in the system [15, 16].

Nitrate-nitrogen concentration in the system with 400 g of *Eucalyptus globulus* Labill was increased (Fig 6). The result because of plant dacay effected nitrate-nitrogen release in the system.

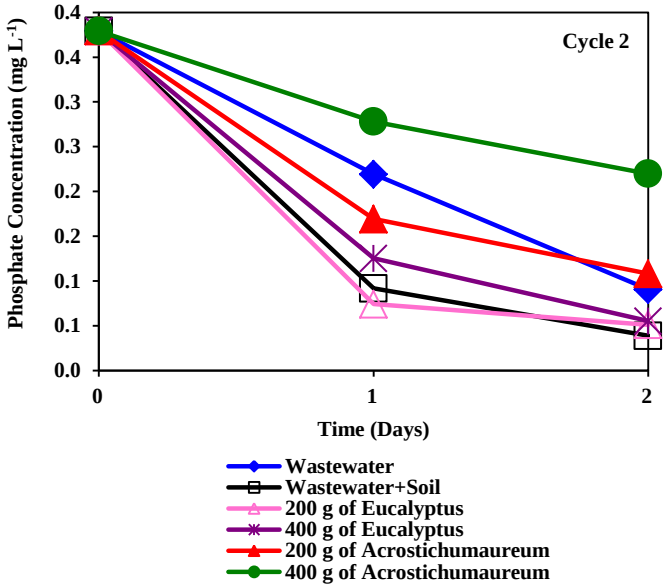

Figure 2. Phosphorus treatment by *Acrostichumaureum* L. and *Eucalyptus globulus* Labill in cycle 2

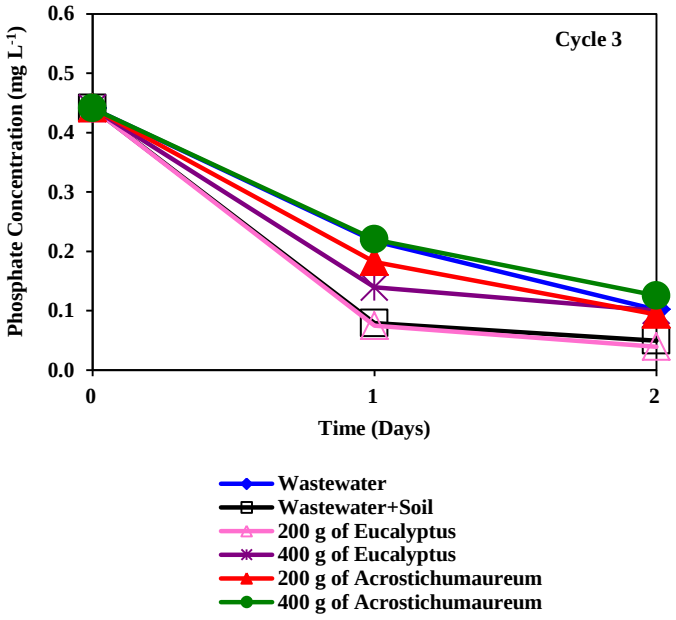

Figure 3. Phosphorus treatment by *Acrostichumaureum* L. and *Eucalyptus globulus* Labill in cycle 3

C. *Biomass of Plants before and after treatment wastewater for 4 cycles*

Acrostichumaureum L. *and Eucalyptus globulus* Labill grown in wastewater for 4 cycles (a month). Biomass of plants was determined after nitrogen and phosphorus treatment. The result found that plant biomass increased all treatments (Table 1). Plants grew well in wastewater because plant roots adsorbed nitrogen in nitrate form and phosphorus in ortho-phosphate form from wastewater available for their growth [14]. The shoots and the roots of both plants extended. This result indicated that nutrients in wastewater promoted plant growth [6]. The plants characteristic was healthy all experiment.

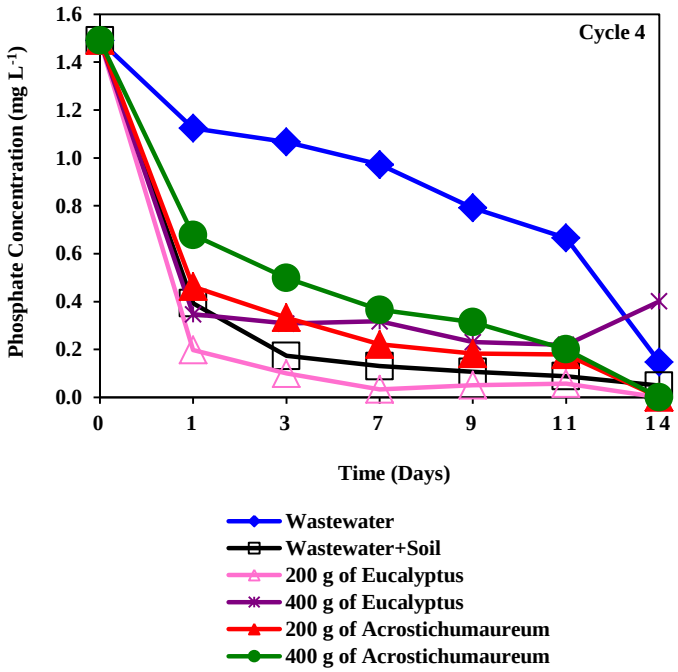

Figure 4. Phosphorus treatment by *Acrostichumaureum* L. and *Eucalyptus globulus* Labill in cycle 4

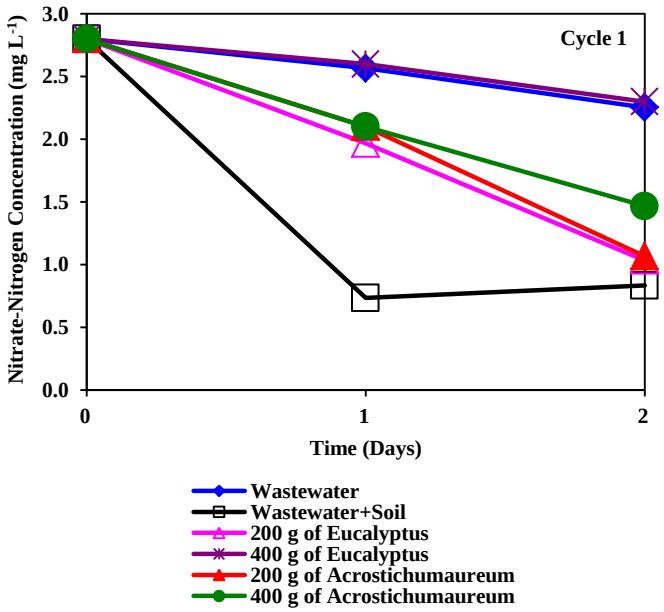

Figure 5. Nitrogen treatment by *Acrostichumaureum* L. and *Eucalyptus globulus* Labill in cycle 1

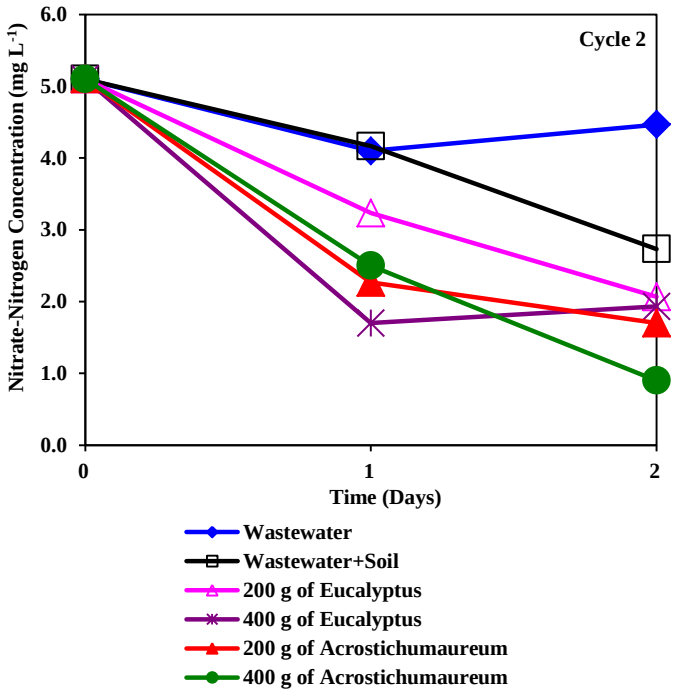

Figure 6. Nitrogen treatment by *Acrostichumaureum* L. and *Eucalyptus globulus* Labill in cycle 2

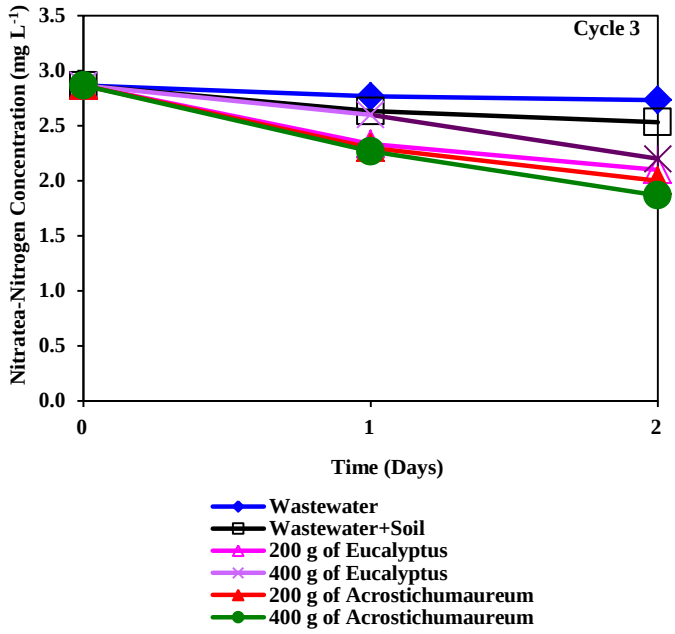

Figure 7. Nitrogen treatment by *Acrostichumaureum* L. and *Eucalyptus globulus* Labill in cycle 3

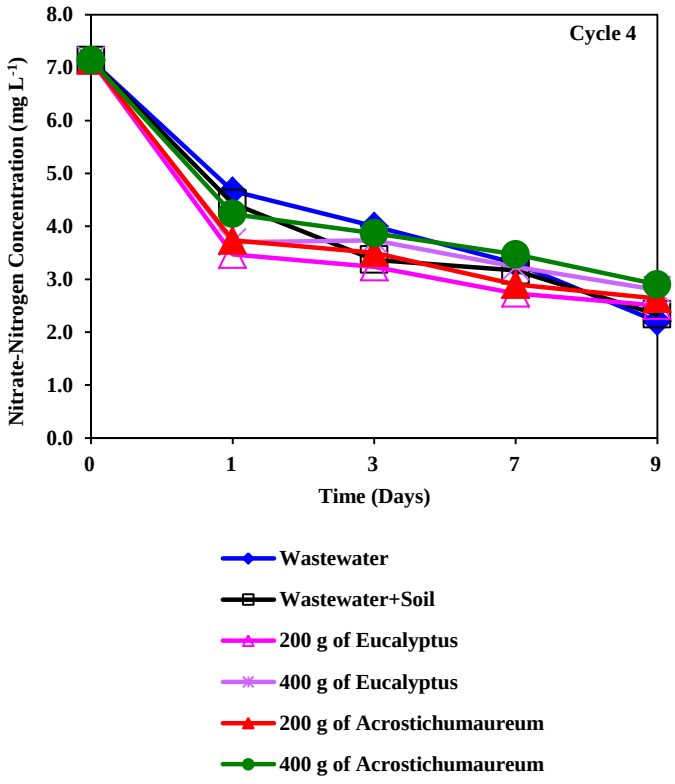

Figure 8. Nitrogen treatment by *Acrostichumaureum* L. and *Eucalyptus globulus* Labill in cycle 4

TABLE I. BIOMASS OF PLANTS BEFORE AND AFTER TREATMENT WASTEWATER FOR 4 CYCLES

Systems	Biomass (g dry weight plant^{-1})	
	Before treatment	After treatment
200 g of *Eucalyptus globulus* Labill+soil+wastewater	35.00±0.00	64.50±2.78
400 g of *Eucalyptus globulus* Labill +soil+wastewater	70.00±0.00	97.00±0.43
200 g of *Acrostichumaureum* L.+soil+wastewater	43.33±0.00	57.75±1.98
400 g of *Acrostichumaureum* L.+soil+wastewater	86.67±0.00	98.00±7.55

IV. Conclusions

Nitrogen and phosphorus in dormitory wastewater of Srinakharinwirot University Ongkaruk were removed by using *Acrostichumaureum* L. and *Eucalyptus globulus* Labill. The best plant efficiency in nitrogen and phosphorus treatment was *Eucalyptus globulus* Labill at 200 g of plant weight. Plant taken up phosphorus and nitrogen from wastewater continuously through 4 cycles. The shoots and roots of plant had prolongation. Moreover, plant biomass after nitrogen and

phosphorus treatment for a month was increased and plants were healthy all 4 cycles. Nitrogen and phosphorus in wastewater were removed by plant until passed standard criteria of USEPA and pollution control department within 2 days. This study indicated that *Eucalyptus globulus* Labill is the new selected plant for nitrogen and phosphorus treatment contaminated in wastewater simultaneously. *Eucalyptus globulus* Labill, which is perennial plant, suits to apply for wetland system.

Acknowledgments

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About Author:

This research studied plants to clean up nitrogen and phosphorus from wastewater. The result found that *Eucalyptus globulus* Labill which is the perennial plant and the raw material to produce paper suit to apply for domestic wastewater treatment.

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