Sustainable Use of Compost from Grease Trap Waste and Water Hyacinth on the Growth Rate of Chinese Kale*

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Abstract. Grease trap waste and water hyacinth is a major problem of sewer clods and impedes water flow, a factor in flooding. Both of which can be proceeded for use as soil amendments. This research had two objectives: 1) to study the appropriate characteristics of the ratio between grease trap waste and water hyacinth for compost production and 2) to study the efficiency of compost from the growth rate of kale. The results of the analysis revealed that moisture, organic carbon, pH, conductivity, C/N ratio, nitrogen, phosphorus, and potassium are conformed to organic fertilizer standards of the Announcement by the Department of Agriculture: Criteria for organic fertilizers 2014, Thailand. Comparison of compost quality from macronutrients revealed that the ratio between grease trap waste and water hyacinth (2:1) was of the highest quality. Comparing the average growth rate of kale by plant height, a number of leaves, leaf width, leaf length, and fresh weight, found that the efficiency of compost containing grease trap waste and water hyacinth (2:1) affected the maximum growth rate of kale. In conclusion, the study found that the utilization of residues can reduce costs for waste management and increase resource renewal, which contributes to sustainability in future.

Index Terms: Sustainable Use, Compost Amendments, Grease trap waste, Water hyacinth, Utilization of waste, Responsibility consumption and production

I. INTRODUCTION

The problem of flooding in urban areas are caused by heavy rainfall and unable to drain water. The growth of population and the continued expansion of industry has increased of fats oils and grease (FOGs), which are components of industrial production and consumption [1]. FOGs are eliminated in the environment, they become more problematic and clog drains, causing wastewater and flooding [2]. The Pollution Control Department investigated that fat and oil were one of the elements found in the community's sewage, 10% of the total organic content [4]. There are use grease trap waste residue to be processed into household products four types: candles, soaps, animal feed and soil amendments [5]. Moreover, water hyacinth, a weed that impact negatively on aquatic ecosystems, which thrive in natural water sources. [6]. The use of grease trap waste and water hyacinth reduces the amount of waste at the source and the utilization of the waste [7,8,9]. This research was to study the issue of wastewater management and waste use at Valaya Alongkorn Rajabhat University under the royal patronage. The problem of accumulation of fat, oil, and grease residues (FOGs) in canteen sewers during the 3-month period accumulated about 200-500 kg of FOGs (wet weight). In addition, water hyacinth problems in natural water sources for a period of 3 months, water hyacinths grow rapidly, requiring dredging. Therefore, the researcher is interested in studying the composting between grease trap waste and water hyacinth in order to solve the problem of waste and use the waste. In addition, a compost amendments suitability study will be conducted by adjusting the ratio of grease trap waste and water hyacinth by experimenting with Chinese kale planting.

II. OBJECTIVES

2.1 To study physical and chemical characteristic of grease trap waste and water hyacinth **(***Eichornia crassipes* **(**Mart**.)** Solms**)** for compost production
2.2 To study the efficiency of compost on plant growth and yield of Chinese kale **(***Brassica albroglabra* L.H.Bailey**).**

III. MATERIALS AND METHODS

3.1 Materials

In this study, the material consisting of grease trap waste and water hyacinth were obtained from the sewers at the cafeteria and natural water pools of Valaya Alongkorn Rajabhat University under the Royal Patronage. Figure 1 shows, the analyzed the properties of two parts: the analysis of the material to be composted (grease trap waste and water hyacinth) and the analysis of the

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composted. Composting material, analyzing for physical and nutrient properties. The second part of the experiment was to study the physical and chemical properties of compost from grease trap waste and water hyacinth.

3.2 Methods

Physical properties of compost include: temperature and humidity. Chemical properties include: electrical conductivity, pH, organic matter content (OC) and carbon to nitrogen ratio (C/N ratio). For the analysis of plant macronutrients are included: nitrogen (using the Kjeldahl wet Oxidation method) Phosphorus, Potassium (Using the Spectrophotometer UV-VIS).

This study analyzes the statistical data were used descriptive statistics include: percentage, average, standard deviation.

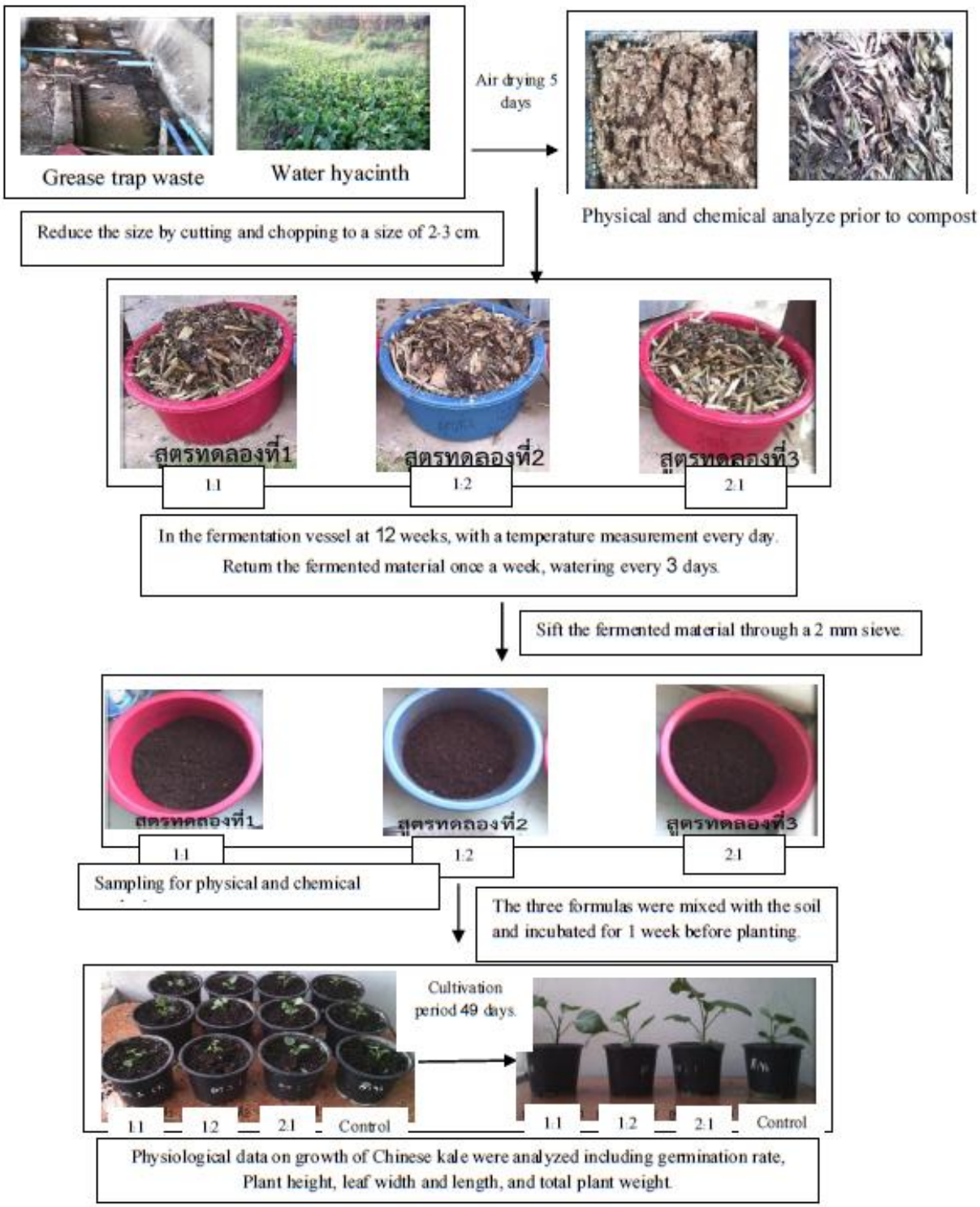

Figure 1. Steps of study grease trap waste and water hyacinth for compost amendments productively for Chinese kale growth.

IV. RESULTS

The results of the analysis of grease trap waste and water hyacinth showed that the moisture content and macronutrients. Table 1 showed that the moisture content of the grease trap waste was 49.5± 0.22, which was higher than the standard less than 30. The nitrogen content of water hyacinth was higher than grease trap waste at 2.02 ± 0.17 and 0.50 ± 0.06%, respectively. The nitrogen content of water hyacinth was related to the standard criteria. Phosphorus and potassium of grease trap waste and water hyacinth**,** according to the standards of organic fertilizer [13].

Table 1. **Characteristic of grease trap waste and water hyacinth** (**n**=**3**)

Parameter	Grease trap waste	Water hyacinth
Moisture Content (%)	49.5 ± 0.22	15.07 ± 0.16
Nitrogen (%N)	0.50 ± 0.06	2.02 ± 0.17
Phosphorus (%P_2O_5)	2.55 ± 0.01	0.74 ± 0.01
Potassium (%K_2O)	1.70 ± 0.01	1.29 ± 0.01

Figure 2 shows the results of the temperature occurring in the composting process**.** The fermentation process in various ratios of grease trap waste and water hyacinth found that during 4-5 weeks the fermentation reaction occurred with the highest temperature in the range of 45-47 °C**.** The higher temperature conditions are caused by the decomposition process of various groups of microorganisms**. [**14**].**

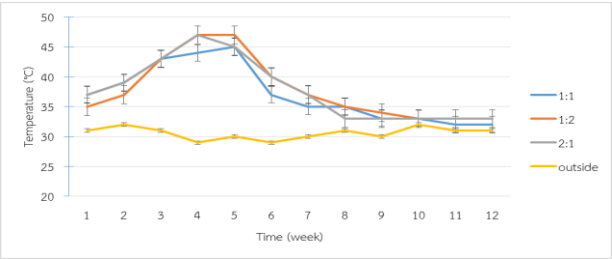

Figure 2. **Temperature conditions of composting between grease trap waste and water hyacinth**.

The results of the analysis of physical and chemical characteristics of the three formulations of soil amendments and soil for planting material are shown in Table 2**.**

The physical characteristics of the soil amendment were dark brown in color, soft, crumbly and clumping**.** The moisture content of the compost amendments over time 12 weeks and then sieve with 2 mm**.** It was found that all three ratio of soil amendments were accordance with the specified standards**.** But for the soil used in the experiment, planting exceeds the standard value at 33**.**99 ± 0**.**08 percent, which the standard specifies not more than 30**%. [**13**].**

The organic carbon content of compost amendments were found at the ratio of 2**:**1 has a maximum value of 40**.**93±0**.**06 **%**, which is twice the standard, which only requires more than 20**% [**13**].** It was found that the ratios 1**:**2 and 1**:**1 were 37**.**44±0**.**06**%** and 33**.**04±0**.**06**%**, respectively**.**

The Conductivity and pH of the three formulas of compost amendment were in the range of 3**.**84 - 5**.**04 µS/cm and 8**.**20-8**.**29, respectively, the parameters are defined according to standard criteria**.** The soil pH was found to be neutral at 7**.**03±0**.**02**.**

The appropriate carbon-nitrogen ratio **(**C/N ratio**)** for the needs of soil microorganism was in the range of approximately 20**:**1 and was therefore taken as the standard value **[**15**].** In the analysis of all formulas of compost amendment, the C/N ratio were in the range of 1**.**31**:**1 - 7**.**22**:**1**.**

The macronutrients of plants consisted of nitrogen, phosphorus and potassium, which were analyzed from the three compost amendment formulations found that all macronutrients were higher than the specified nutrient standards**.** Nitrogen is in the range of 2**.**12 - 2**.**94 percent**.** Phosphorus is in the range of 0**.**77-0**.**95**%.** Potassium is in the range of 1**.**34-1**.**74 **%.**

Table 2. **Physical and chemical properties of compost amendments and soil** (**n**=**3**)

Parameter	Grease waste and Water hyacinth ratio			Soil (Control)	Standard*
	1:1	1:2	2:1		
Moisture Content (%)	27.16±0.03	26.19±0.22	29.44±0.20	33.99±0.08	< 30
Organic carbon (%)	33.04±0.06	37.44±0.06	40.93±0.06	22.32±0.01	> 20 (w/w)
Conductivity (µS/cm)	4.11±0.03	5.04±0.14	3.84±0.08	0.96±0.01	< 10
pH	8.25±0.06	8.20±0.58	8.29±0.17	7.03±0.02	5.5-8.5
C/N ratio	1.31:1	4.46:1	7.22:1	12.13:1	< 20:1
Nitrogen (%N)	2.94±0.06	2.12±0.58	2.46±0.17	0.63±0.02	> 1.00
Phosphorus (%P_2O_5)	0.88±0.01	0.77±0.01	0.95±0.01	0.46±0.01	> 0.5
Potassium (%K_2O)	1.35±0.01	1.34±0.01	1.74±0.01	0.54±0.03	> 0.5

***** Criteria for organic fertilizers, **(**2014**). [**13**]**

The germination rate of kale plants with a cultivation period of 49 days using three different compost amendment formulas was found at the ratio of 1**:**2 and 2**:**1 to have a hundred percent germination effect as

shown in Table3**.** In addition, the yield study of Chinese kale showed that the 2**:**1 ratio was the highest at 12**.**52 ± 0**.**45 g/plant, followed by the 1**:**2 and 1**:**1 ratio at 11**.**50 ± 0**.**44 and 8**.**60 ± 1**.**36 g/plant, respectively**.**

Table 3. **Percentage of germination rate and yield of Chinese kale** (**n**=**3**)

Treatment	Germination rate (%)	Yield (g/plant)
1:1	96.67 ± 0.58	11.50 ± 0.44
1:2	100 ± 0.00	8.60 ± 1.36
2:1	100 ± 0.00	12.52 ± 0.45
Control	83.33 ± 0.58	7.59 ± 0.61

In Figure 3, the results of the study on the height of Chinese kale were shown in the ratio of 2**:**1 is the highest at 20**.**00±1**.**87 cm**.** The inferior height ratio is 1**:**1 and 1**:**2 at 19**.**20±0**.**44 and 17**.**46±1**.**08 cm, respectively**.** For the planting material without soil amendment, the height was 12**.**53±0**.**38 cm.

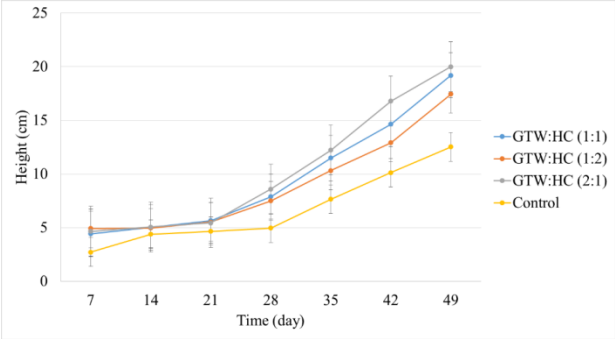

Figure 3. **Effect of compost treatment on plant height of Chinese kale**

In Figure 4, the number of leaves of Chinese kale from the experiment showed that the ratio with the highest number of leaves was 1:2 and 2:1 at 7.6±0.58 leaves per plant.

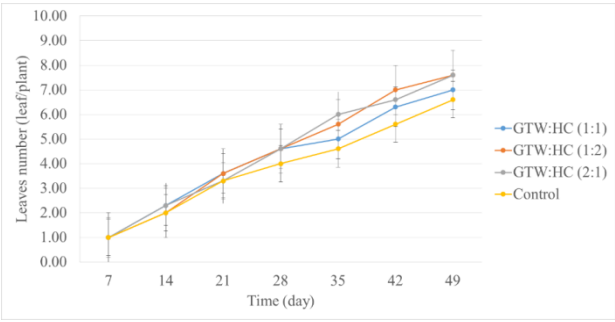

Figure 4. **Effect of compost treatment on leave number of Chinese kale**

In Figure 5 showing the average width of Chinese kale leaves, it was found that the ratio of the leaves with the greatest mean width was 1**:**1 and 2**:**1 at 7**.**70 cm**.**

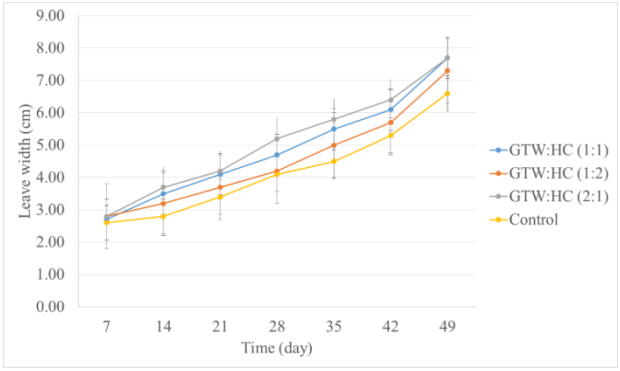

Figure 5. **Effect of compost treatment on leave width of Chinese kale**

In Figure 6, the average length of Chinese kale leaves showed that the ratio with the highest mean leaf length was 2**:**1 at 10**.**20±0**.**55 cm, followed by the ratio of 1**:**1 and 2**:**1 at 9**.**20±0**.**83 and 8**.**10±0**.**15 cm, respectively

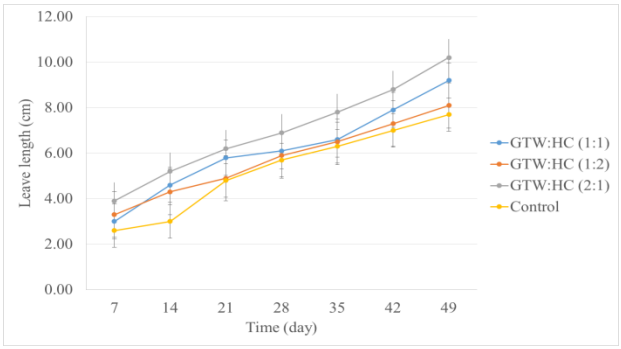

Figure 6. **Effect of compost treatment on leave length of Chinese kale**

V. DISCUSSION AND CONCLUSION

This study found that grease trap waste and water hyacinth has the potential to be used as a soil amendment **[**1,4**].** The growth effect of Chinese kale showed the efficiency of a soil amendment containing grease trap waste and water hyacinth beneficial for growth**.** The high nitrogen content increases the yield especially of leafy plants and accelerates plant growth **[**16**].** The soil amendment produced with high nitrogen content in all three ratios was in the range of 2**.**12**%** - 2**.**94 percent, qualified as compost standards **[**17**].** Comparatively, the nitrogen value of the soil amendment in this study was higher than that of the indigo soil amendment at 1**.**85**%** **[**18**].** The effectiveness of soil amendment ratio at of 2**:**1 had the best germination rate**.** In addition, Chinese kale was found highest yield in terms of weight, leaf number, height, leaf length, and leaf width**.** Grease trap waste and water hyacinth that must be eliminated, which raises the cost and impact on the environment**.** The fermentation process of both types of waste material produces an efficient soil conditioner with macronutrients **(**N, P, and K**)** that are suitable for plant cultivation**.** Utilizing grease trap waste and water hyacinth to produce soil amendments is a simple process and takes only three

months and does not require advanced production technology. The utilization of residues can reduce costs for waste management and increase resource renewal, which contributes to sustainability in future.

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