

# Effect of several types of sludge resulting from activities and concentration on growth and yield of Brassica juncea

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## Effect of several types of sludge resulting from activities and concentration on growth and yield of *Brassica juncea*

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**Abstract.** The aims of this study were to analyse and test several types of activated sludge to find out the safe and environmentally friendly fertilizer raw material standards, analyse the characteristics and number of activated sludge components that are potentially safe to use and find out fertilizer raw material standards and also test the response of plants which use the several types of activated sludge in supporting the growth and plant yields that are safe for consumption. The method used is the potential study using a comparative method. The number of raw materials and types of fertilizer raw materials using survey methods and mathematical calculations. The result indicated that the process of wastewater treatment technology that uses waste technology is classified as good and used standards operational with utilization concept. Waste water in terms of quality and characteristics is considered safe and has a large potential to be used as raw material for fertilizer. Fertilizers sourced from the results of wastewater treatment response to the fresh weight of leaves of *Brassica juncea* is higher if compared to biofertilizer and chemical fertilizer at the same dosage.

### 1. Introduction

Activated sludge is a simple compound consisting of liquid, dissolved solids and suspended solids originating from plant residues, animal waste, food scraps, waste that has undergone a process of decomposition, fermentation, and mineralization. Active sludge has the potential to be used as a raw material for fertilizer because it contains organic materials of around 60% -70% and several types of microorganisms [1]. The high content of organic matter of sludge is used as a raw material for organic fertilizers because it can improve the physical and chemical properties of the soil. Sludge also contains several component components which are needed by plants such as: mineral elements (N, P, K, Mg, Ca, Mn, Fe, Mn, Zn, Cu, B, Al, Mo); amino acids (Asparigin, glycine, methionine, phenylalanine, proline, alanine, isoleucine, lysine and others); Hormones (Gibberellin, Zeatin, IAA); and microorganisms (Protozoa, Fungi, Fungi, Bacteria). The mineral content is formed from the process of decomposition and fermentation by microorganisms in certain environmental conditions [2].

Raw materials to be used for fertilizers must contain high organic matter in the form of carbohydrates and proteins [3]. Some research results show that the use of sludge can increase the growth and yield of rice plants by around 20-30% and the efficiency of chemical fertilizer use is around 40-60%. Besides being beneficial, sludge can also cause environmental pollution such as odour, colour and spread



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disease. The results of several studies on the use of sludge found the presence of bacteria such as salmonella in food crops and industry. Today there is no standard for the utilization of the type of sludge that is safe to use for agriculture. For this reason, analysis and standardization are needed through research. Through this research, it will be able to produce a type of fertilizer with the right level of concentration to increase growth and safe and environmentally friendly agricultural products.

The objective of the study is to discover the safe and environmentally friendly types of activated sludge fertilizer in accordance with the standards of fertilizer raw materials. The use of activated sludge is one of the alternative sustainable agriculture systems that recycle local resources that are cheap, efficient, easily available and environmentally friendly. This will have an impact on increasing the income of local vegetable farmers on an ongoing basis, as well as increasing the efficiency of the use of chemical fertilizers. The process of wastewater treatment technology that uses waste technology has met standard operational procedures so that it is safe to use as fertilizer. The use of fertilizer raw materials produced by wastewater treatment using waste technology gave a positive response to Brassica juncea.

## 2. Material and methods

The study was conducted at the Greenhouse Laboratory of the Faculty of Agriculture, Warmadewa University, Denpasar, Bali. This research started from May to October 2018.

The method used in this study was a survey of activities and potential areas and continued by testing, analysis, and experiment of the Brassica Juncea response for the treatment of activated sludge types with agricultural technology systems available with factorial experiments.

Assessing the potential of raw materials regarding the amount, raw material, source of raw materials, area of activity, type of activity, type of raw materials used, habits of use by farmers, utilization process, process technology used all data parameters use survey methods (primary data collection and secondary data) for recommendations for testing of activated sludge fertilizer raw materials.

Data from the research were analyzed statistically using variance analysis. For a single treatment that has a significant effect until very real, it is followed by an LSD test of 5% level [4]. Furthermore, an analysis of farming feasibility was also carried out.

## 3. Results and discussion

The results of laboratory tests showed that the wastewater used as the sample in this study included the type of domestic wastewater. Domestic wastewater is dominated by organic matter in the form of protein and carbohydrates as indicated by the parameters BOD (22.63 mg/l), COD (47 mg/l), TSS (25.83 mg/l), ammonia (0.17 mg/l), nitrate (4 mg/l) and nitrite (0.20 mg/l). Raw materials for fertilizers must contain organic ingredients in the form of carbohydrates and proteins [5].

The results of the analysis of the stages of the waste technology treatment process indicate that the technology has met operational standards, namely emphasizing biological principles with the concept of utilization and the results of quality of waste safe, efficient, environmentally friendly. This can be seen from the quality of the wastewater produced already meeting the quality standards and safe to use. Declining turbidity values, dissolved solids, and suspended solids are caused by treatment of process stages (pretreatment, treatment, and stabilization) where there is a decrease in the content of solids and the separation of particle components from liquids. Decreasing the content of solids and separation will affect the level of sedimentation and the simpler form of particle components [6].

The technological treatment provided in the stages of treatment and stabilization aims to speed up the process, and regulate the number of components and maintain environmental conditions. The aeration treatment of 3.3 hours will affect the bioactivity and biodegradation of organic matter by microorganisms, especially aerobic bacteria. The treatment of F/M 0.24-0.5g/BOD/day/g MLSS will affect the balance of the amount of food and population of microorganisms based on energy needs such as heterotroph and autotroph bacteria. The treatment of waste residence time 2-4 days and wastewater flow by 35% affect the availability of oxygen, the number of food substances (organic matter), the residence time of waste and finally affect the number and component elements. According to Pauwels and Verstraete states that the regulation of the speed of wastewater flow and waste residence time will

affect the quality, characteristics, amount of sludge and environmental conditions such as oxygen availability, temperature, and pH. Standard treatment of wastewater flow (recirculation sludge) 50-60% and standard sludge age 6-10 days with the amount of wastewater > 1500 m<sup>3</sup> [7]. This is supported by the results of the research by Kasmidjo showing that waste with a BOD level > 1900 with a treatment of wastewater flow (recirculation sludge) 50% will be able to reduce the BOD value by about 98-95% and maintain a dissolved BOD content of 50 ppm [8]. The technological treatment provided in the treatment and stabilization stages aims to speed up the process because the amount of waste is quite large and the level of pollution is high.

The results of Murachman show that giving oxygen (DO) of 0.8-4.0 mg/l can increase the bioactivity of microorganisms to suppress CH<sub>4</sub>, H<sub>2</sub>S and CO<sub>2</sub> elements around 60% -80% [9]. Elemental components found in the composition of wastewater such as temperature, pH, DO, sulfide, chloride, and microorganisms are also able to suppress and simplify organic and inorganic pollutants [10]. Increased temperature will accelerate enzymatic reactions that increase the bioactivity of microorganisms in decomposing pollutants, while an increase in pH will accelerate the process of decomposition of organic matter (BOD, COD) by microorganisms [11]. Sulfides in a certain amount will be able to bind molecules into floc and can reduce turbidity values by around 35-60% [12]. The chloride element through the chlorination process will be able to agglomerate (floculate) the elemental components and kill pathogenic bacteria [13]. The characteristics of wastewater are influenced not only by the type and source of wastewater but also by the process of decomposition, fermentation, and mineralization [1]. The process involves several types of microorganisms, thus requiring the availability of oxygen, food substances and environmental conditions (pH and temperature). The results showed that the process of oxidation and reduction of organic matter by microorganisms requires a standard treatment of pH 6-8 and temperatures of 200C - 600C with the amount of wastewater > 1500 m<sup>3</sup>/day [14]. The process of bio-assimilation of organic matter by microorganisms requires standard oxygen treatment 2-8 hours/day at the treatment stage with a BOD load of 500 mg/l [8]. The process of the speed of bioactivity and biodegradation of organic matter by microorganisms requires standard treatment of F/M 0.2-0.5 g BOD/day/ MLSS [15].

### *3.1. Plant response to several types of fertilizer raw materials sourced from activated sludge*

During the study, there were no disturbances in pests and diseases in plants, so there was no need to control pests and diseases. The results of statistical analysis showed that the interaction of type treatment and dosage of fertilizer raw materials from the results of several wastewater activity sources applied to green vegetable plants only showed a very significant effect ( $P < 0.01$ ) on fresh leaf weight per plant and total fresh plant weight per plants (Table 1). Both the type and dosage of fertilizer raw materials showed a very significant effect ( $P < 0.01$ ) on the observed variables (Table 1).

Laboratory test results on sludge obtained macro and micronutrients namely nitrogen 1.97%, phosphorus 0.78%, potassium 0.43%, Calcium 0.48%, sulfur 0.33%, magnesium 0.19 %, iron 236 ppm, aluminum 211 ppm, manganese 18.8 ppm, molybdenum 2.18 ppm and positively contain amino acids, hormones, and microorganisms. According to Harker et al. the need for nutrients by microorganisms affects the availability of nutrients in the composition of wastewater [16]. On the other hand, Yowono said that the content of most elements and microorganisms is found in TSS (total suspended solids) [17]. To assess the feasibility of wastewater samples used as fertilizer raw materials, testing was carried out using the hydroponic method. The results obtained were that the type of fertilizer treatment had a very significant effect ( $P < 0.01$ ) on all plant parameters observed. The results of the variance test on the fresh weight of leaves showed a very significant effect on the Duncan test level of 1%. The results of the statistical analysis of the response of green vegetable plants after application with fertilizer raw materials resulting from the process of waste and wastewater technology are presented in Table 1.

**Table 1.** The significant influence of the type of fertilizer raw material (J) and the dosage of fertilizer raw material (K) and its interaction (JxK) on the growth and yield of Brassica juncea.

No	Variable	Treatment		
		J	K	JxK
<b>1 Plant growth</b>				
1.	Maximum plant height	**	**	ns
2.	Maximum number of leaves	**	**	ns
3.	Leaf area at age:			
	10 days after planting	**	**	ns
	20 days after planting	**	**	ns
	30 days after planting	**	**	ns
<b>2 Plant Yields</b>				
1.	The Weight of fresh leaves per plant	**	**	**
2.	The weight of fresh roots per plant	**	**	ns
3.	The total weight of fresh plants per plant	**	**	**
4.	The Weight of oven dry leaves per plant	**	**	ns
5.	Oven dry root weight per plant	**	**	ns
6.	Total weight of oven dry plants per plant	**	**	ns

\*\* = very significant effect ( $P < 0,01$ ), ns = non significant effect ( $P \geq 0,05$ )

### 3.2. Effect of interactions between types and dosages of fertilizer raw materials

The highest weight of fresh leaves per plant was produced by waste at a dosage of 15 g/polybag, which was 19.90% and 17.35% higher than that in Bio Fertilizer and Chemical Fertilizer at the same dosage as well as 15 g/polybag dosage fresh leaf weight was 56.86% higher than 0 g/polybag dosage in 47.00% Waste and 37.13% Waste in Bio Fertilizer and Chemical Fertilizer (Table 2). Waste at a dosage of 20 g/polybag gives lower fresh leaf weight than the dosage of 15 g/polybag but is significantly higher than the dosage of 10 and 0 g/polybag. At a dosage of 20 g/polybag in Bio Fertilizer gives a different fresh leaf weight which is not significant with other dosages. The use of a dosage of 20 g/polybag of chemical fertilizer turned out to provide the lowest fresh leaf weight but was not significantly different from that value in other dosages in chemical fertilizer (Table 2).

**Table 2.** The effect of the interaction between the treatment of type and dosage of fertilizer raw materials on the weight of fresh leaves per plant.

Treatment	Type		
	Waste Fertilizer (K)	Bio Fertilizer (B)	Chemical Fertilizer (V)
Dosage (g/polybag)			
0 (K <sub>0</sub> )	4.40 de	4.33 de	5.30 d
10 (K <sub>1</sub> )	4.87 de	3.50 ef	4.17 de
15 (K <sub>2</sub> )	10.20 a	8.17 b	8.43 b
20 (K <sub>3</sub> )	6.73 c	4.67 de	2.57 f

The numbers followed by the same letters are not significantly different from Duncan's 5% distance test

The high weight of fresh leaves per plant in the treatment of types of waste fertilizer raw material at a dosage of 15 g /polybag (K<sub>2</sub>), is closely related to the complexity of the element components and the availability of more nutrients. Organic minerals function as triggers for plant growth and development [11]. Amino acids are useful in improving the quality of growth and yield of plants. The hormone functions to stimulate the growth of new shoots [18]. Functioning microorganisms besides being able to remodel the elements so that they are also available as nitrogen fixers in the air [19]. Rhizobium which is associated with legume plants can add 100-300 kg N / ha in one season and leave a number of N for

the next crop [20]. Azotobacter is an N binding bacteria that is not associated with plants and can reduce the need for nitrogen fertilizer by 25% - 50% [19].

The dosages of 15 g/polybag in the types of waste, biofertilizer and chemical fertilizer gave fresh root weight (3.22 g), leaf weight (2.97 g), roots (0.996 g) and the highest total dry plant oven (3.16 g) and significantly higher than each of these variable values at other dosages, except for the 10 g/polybag chemical dosage (Table 1). The dosage of 20 g/polybag in Waste, Bio Fertilizer, and chemical fertilizer significantly reduced fresh root weight, leaf weight, root, and total oven dryness compared to 15 g/polybag dosage. Waste with a dosage of 15 g/polybag produced total fresh weight (14.13 g /plant), which was 26.19% and 16.28% higher than the total weight of fresh plants produced by Bio Fertilizer and Chemical Fertilizer as well as significantly higher and higher values the other treatment (Table 3). A dosage of 20 g / polybag increases the total fresh weight of the plant compared to control (0 g/polybag) in Waste and Bio Fertilizer but decreases the value of the variable in chemical fertilizer.

**Table 3.** The effect of the interaction between the treatment of type and dosage of fertilizer raw materials on the total weight of fresh plants per plant.

Treatment	Type		
	Waste Fertilizer (K)	Bio Fertilizer (B)	Chemical Fertilizer(V)
Dosage (g/ polybag)			
0 (K <sub>0</sub> )	5.90 e	5.70 e	6.47 e
10 (K <sub>1</sub> )	7.20 de	4.80 ef	5.90 e
15 (K <sub>2</sub> )	14.13 a	10.43 be	11.83 b
20 (K <sub>3</sub> )	9.07 ed	6.40 e	3.23 f

The numbers followed by the same letters are not significantly different from Duncan's 5% distance test.

The increase in the supply of fertilizer from the waste technology from 0 g/polybag to 15 g/polybag was apparently not accompanied by an increase in the growth and yield of fresh green vegetables in the treatment of 20 g/polybag compared to control (0 g/polybag). The low yield obtained in a higher dosage treatment (20 g/polybag), probably caused by too high concentrations of dissolved salts (soluble salts) given at that dosage. Excessive element concentration causes fertilizer conditions to be more sodic while excessive salt concentrations cause more saline conditions [21]. In a state of high element concentration coupled with an increase in pH causing increased levels of salinity resulting in a system of enzymes, cytochromes, respiration, transportation of the substrate and finally replication of plant cell nucleus material to a halt.

#### 4. Conclusion

The conclusion obtained from the results of this study is that the process of wastewater treatment technology that uses waste technology has met operational standards with the concept of utilization. Wastewater from the aspect of quality and characteristics is safe and has the potential to be used as raw material for fertilizer. The use of fertilizer raw material produced by wastewater treatment using waste technology responded to the fresh weight of leaves per plant higher by 19.90% and 17.35% compared to that value in Bio Fertilizer and Chemical fertilizers at the same dosage.

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