Utilization of sugar factory wastes as an ameliorant on sugarcane seedling media with bud chips technique

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Abstract. Filter mud and boiler ash are sugar factory wastes that have benefits as a soil amendment. The huge quantities of unutilized filter mud and boiler ash was a fuel of this study. The aim of this research is to analyze the effect of sugarcane wastes to planting media for bud chips sugarcane nurseries. This experiment was used randomized group design with three different planting media, consisting of filter mud and soils (P1), boiler ash and soils (P2), and soils only (P3). The sugarcane seeds used were bud chips sugarcane with Bululawang varieties. The results showed that the application of sugar factory wastes in planting media was able to enhance the sugarcane plant growth, including the amount of leaves, the diameter of stem, wet and dry weight of plants in 8 weeks after planting. Sugarcane wastes did not significantly improve the height of plants dan plant roots. Combinations of filter mud and soils has the highest value of vegetative growth compared to other media.

1. Introduction

Sugarcane (Saccharum officinarum) is a major agriculture crop grown in tropical and subtropical region. Sugarcane production in the word reach until 186.7 million tons in 2017/2018, increase 11 percent than 2016/2017 season [1]. Most of peoples in the world consumed sugar from sugarcane plant than other sugar sources, like beets, maize and others. The demand of sugar in Indonesia increase every year so the way to increase the production of sugarcane is needed.

The problem in sugarcane production is the availability of quality seed. The farmers usually use stem cutting (bagal) from previous planting. About 6-8 tons seed cane ha-1 needed in conventional method and transporting, handling also seed storage the large mass of planting material as a problem if stem cutting used in sugarcane cultivation [2]. Another way to supply sugarcane seedling is using bud chip technologies. By using bud chip technologies, the number of seedling is more than stem cutting because we just using the bud of sugarcane. Bud chip method also had number of tiller plant-1 and percentage of survival on yield higher than conventional method [3]. The buds planting in pot until the seedling was ready to replanting. One of the influencing factor that affected to sugarcane seedling in nurseries is planting media. The planting media supply of nutrient for plant and water also affected to root growth [4].

Sugar and molasses are main product from sugarcane industry. Generates residue was also produced in sugarcane industry such filter mud, boiler ash, vinasse and bagasse. Those residues have great potential in agriculture as a fertilizer or soil ameliorants. But they were not optimally utilized. Filter mud was resulted from sugarcane extraction. Filter mud contains some organic matter [5], so it can be plant
nutrient supplier and soil ameliorant [6]. Filter mud contains macro and micro nutrient that suitable for plant grown. The raw press mud contains organic matter 39.59%, N (2.95%), P (0.31%), K (0.54%), Ca (5.52%) and other micro nutrient Cu, Fe, Mn and Zn (5). Boiler ash is the ash that resulted from sugarcane extraction burning. Boiler ash contains plant nutrient as Silica (SiO2) dan Alumina (Al2O3) each between 30-97% dan 5-9% [7]. Boiler ash also contains Fe, Ca, Mg, S and K. The utilizations of boiler ash at some doses as soil amendments increasing soil porosity [8].

Study in Indonesia, show that the utilization of filter mud and boiler ash in sugarcane yield 60 t ha-1 increasing plant height and number of tiller at 4 months after plant [9]. Due to filter mud and boiler ash have beneficial for agriculture it has to be studied about the utilizations of sugar industry waste for seedling in bud chips technique.

2. Materials and method
The research was conducted in Tersana Baru sugarcane industry, Cirebon district West Java from November 2017 to January 2018. Sugarcane stem Bululawang varieties with the age of 6 months was selected as a source of bud chip seedling. The stem cutting with bud chip machine and selected buds used as seed. The seedling that contain one bud was soaking with warm water (50°C) for 5 minutes. Then the buds were planted in polybag with the different planting media based on the treatment. An organic fertilizer as compound an organic fertilizer, NPK (15-15-15) used in seedling media was 3 g and given at 4 weeks after planting. The seedling was received irrigation and weed controlled manually.

The experiment was used randomized group designed and each treatment was replicated three times. Three planting media as a treatment was designed in this research and show in table 1. Observed variable were plant height, stem diameter, number of leaves, fresh and dry weight. Those variables were measured at 2, 4, 6, and 8 weeks after planting (WAP).

| Code | Treatment of planting media          |
|------|--------------------------------------|
| P1   | Soil + filter mud (1:1 v/v)          |
| P2   | Soil + boier ash (1:1 v/v)           |
| P3   | Soil                                 |

3. Results and discussion

3.1. Plant height and stem diameter
Based on table 1 plant height and stem diameter was affected by soil ameliorant in six and eight weeks after planting (WAP), but those treatments not significantly in plant height variable at eight WAP.

| Planting Media | Plant Height | Stem Diameter |
|----------------|--------------|---------------|
|                | 6 WAP | 8 WAP | 6 WAP | 8 WAP |
| P1 | 44.17 a | 56.92 a | 0.54 a | 0.71 a |
| P2 | 32.43 b | 51.53 a | 0.46 b | 0.63 ab |
| P3 | 30.22 b | 45.78 a | 0.41 b | 0.59 b |

Notes: The number that followed by same letters was not significantly different by using Tukey test at 5%

The increasing plant height and stem diameter were correlated with the abundant of P, K, and other micro nutrients in planting media. The additions of soil organic matters also improve soil physic properties. Repairing soil porosity affected to plant growth, especially root and shoot growth as well as the adequate of essential plant nutrition’s [8].
3.2. Number of leaves
Leaves is plant organ of photosynthesis occurred. Photosynthetic affected by the amount of chlorophyll and nitrogen absorption. Application of nitrogen fertilizer to the plant will increase the number of leaves and increasing plant growth due to increasing of photosynthetic process [10].

Statically analytic in table 2 showed that the additions filter mud and boiler ash significantly affected to number of leaves at eight weeks after planting. There is tendency to increasing number of leaves by giving soil ameliorant both filter cake and boiler ash than without ameliorant. The utilization of filter mud as a planting media (P1) have highest average number of leaves (4.58) while P3 have lowest 4.16 number of leaves.

Table 3. Leaves number of sugarcane seedling with various media planting.

| Planting media | 2 WAP | 4 WAP | 6 WAP | 8 WAP |
|----------------|-------|-------|-------|-------|
| P1             | 2.73 a| 3.02 a| 3.58 a| 5.14 a|
| P2             | 2.08 a| 2.41 a| 3.73 a| 4.58 ab|
| P3             | 2.32 a| 2.37 a| 3.06 a| 4.16 b|

Notes: The number that followed by same letters was not significantly different by using tukey test at 5%

Filter cake and boiler ash are sugar industry wastes contains sufficient macro and micro nutrient also improved soil properties. Filter cake increasing N, P and K nutrient that useful for plant growth [11]. While, boiler ash not only contain SiO₂ but also sufficient macro nutrient such Ca, Mg and K [8]. Nitrogen and magnesium are important minerals of chlorophyll that responsible to photosynthetic process [12], which the photosintat as an energy source to increasing vegetative stage including number of leaves [13].

3.3. Fresh weight and dry weight of plants
Weight of plants was correlated with the leaves number. Different planting media affected to fresh and dry weight of plants at 8 WAP (Table 3). P1 treatments of planting media gave the highest fresh and dry weight of plant and did not significantly different with P2 seedling media.

Dry weight is an indicator to determine vegetative growth rate of plants [14]. Based on table 4, application of soil ameliorant affected to dry weight. Enrichment of filter mud to plant media gave the highest fresh and dry weight compared the others. Seedling media without adding of ameliorant gave the lowest dry weight of plant.

Table 4. Plant height and stem diameter of sugarcane seedling with various media planting.

| Planting media | Fresh weight of Plant (g) | Dry Weight of Plant (g) |
|----------------|---------------------------|-------------------------|
| P1             | 20.00 a                   | 15.67 a                 |
| P2             | 18.00 ab                  | 12.00 ab                |
| P3             | 10.67 b                   | 5.00 b                  |

Notes: The number that followed by same letters was not significantly different by using tukey test at 5%

Increasing weight of plant both dry or fresh weight affected to nutrient status in seedling media. Filter muds contain organic content and mineral were needed by plant such as nitrogen, phosphorus, potassium, calcium, magnesium, and sulphur [15]. Boiler ash also increasing Ca, Mg, K, P, and micronutrient to the soil [8]. Those mineral nutrients have specific function to plant metabolism so the availability significantly effect to plant growth.

The using boiler ash and filter muds as soil ameliorant affect to physical properties of soil. Organic matter was negatively correlated with soil bulk density. Soil bulk density was decreased by adding of organic matter [16].
4. Conclusion

As a sugarcane industry wastes filter mud and boiler ash have a beneficial function as a soil ameliorant although unutilized optimally. Filter mud and boiler ash contain sufficient nutrient for plant growth both macro and micro nutrient The present finding show both filter mud and boiler ash increasing plant growth component in sugarcane bud chip nurseries, including plant height, stem diameter, number of leaves and weight of plant.

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