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The application of amendments to increase nutrients absorption of *Petiveria aleaceae L.* (Singawalang) in peat soils

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Abstract. The nutrient availability in peat soils is low. The initial analysis of peat soils in Rawa Pening showed acidity of 5.07; Carbon (C) organic of 18.18 %; total Nitrogen (N) of 1.6; Phosphate (P) of 1.63 ppm; Kalium (K) of 13.29 ppm; whereas Cation Exchange Capacity (CEC) level was high (85.94 ppm). The application of Dolomiteor Zeolite amendments of 2.5 t/ha for 3 weeks incubation showed to increase the soil acidity to 6.55 and 6.7, respectively. Singawalang (*Petiveria Alleaceae.L*) is an herbaceous, annual plant with medicinal properties. *P.alleaceae* was shown to contain astilbin, benzal dehyde, and coumarin phytochemicals with anti- tumor and/or anti-cancer properties. This study aimed to improve the nutrients absorption ability of *P.alleaceae* with Dolomite, Zeolite and NPK fertilization. *P.alleaceae* were plant polybag using peat soils medium by Completely Random Design (CRD). Zeolite, Dolomite (2.5 tons/ha) and NPK Fertilizer 15:15:15 at a dose of (0;1.5;3;4.5) g/plant were applied. The results showed that all treatments failed to improve the growth and uptake parameters of N, P, K. Except for the total chlorophyll lamount. Zeolite with NPK showed higher increase of the total chlorophyll amount compared to Dolomite with NPK.

1. Introduction

Rawa Pening peat soil consists of plant debris that has been weathered and is common for nursery media and media mixes for ornamental plants in pots. Chemically peat soils have high soil acidity due to organic acids and decomposition of organic matter in anaerobic conditions. Peat soil has a high cation exchange capacity (CEC) but very low base saturation (base saturation) so that the availability of nutrients, especially potassium (K), calcium (Ca) and Mg, is low. Likewise, the Nitrogen and Phosphorus elements in peat soil are found in organic P forms were less available for plants [1].

One alternative effort to increase nutrient availability on peat soil is the provision of balanced amendment and fertilization, site-specific based on soil testing and crop needs. Zeolite as an amendment is used with a combination of minerals or organic fertilizers to improve plant growth. Zeolites are also able to maintain soil moisture, soil structure, and regulate soil nutrition [2]. Dolomite is an effort to improve the physical, chemical and biological properties of the soil. The chemical properties that are corrected by liming are increased soil pH, increased availability of essential nutrients, and decreased activity of Al, Fe and Mn which are toxic if excessive. Besides, Dolomite was able to increase N and Ca nutrients but causes imbalances P, K, and Mg [3].

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Singawalang (*Petiveria alleaceae.L*) is an herbaceous, annual plant with medicinal plant characters. *P. aleaceae* was shown to contain astylbin, benzaldehyde, and coumarin phytochemicals with anti-tumor and/or cancer properties [4]. The main problem with sustainable use of natural medicinal plants either in national international scale is the availability of the raw material. The important value of medicinal plants is the content of secondary metabolites and its productivity is strongly influenced by environmental factors such as the stress response and both biotic and abiotic environments [5]

This study aims to improve nutrient absorption ability of medicinal plants *P.alleaceeae* with the application of Dolomite, Zeolite and NPK fertilization on peat soil.

2. Materials and methods

The study was conducted in April to August 2014 in the village of Wedomartani, Sleman, Jogjakarta. Peat soil media was taken from Rawa Pening, Central Java at 70170 S.L. and 1010260 E. L. At the beginning of the study a chemical and texture of peat soil analysis was carried out. Research using Rawa Pening peat media in polybag with CRD research design. Soil media and 2: 1 organic fertilizer so that it becomes 5 kg / polybag.

The treatments were Amendments: Dolomite and Zeolite 2.5 t/ha or 8.75 g/polybag, respectively. NPK Fertilize (Nitrogen, Phosphorus and Potassium) 16:16:16 with a dose (0; 1.5; 3.0;4.5) g/plant.

Amendments were given at the beginning of the study and incubated for 3 weeks. Observation parameters on plant growth, chlorophyll and nutrient uptake were carried out in the study area when the plant was three months old.

3. Results and discussion

The nutrients availability in peat soils is low. The initial analysis of peat soils in Rawa Pening showed acidity of 5.07; Carbon (C) organic of 18.18%; total Nitrogen (N) of 1.6; Phosphate (P) of 1.63 ppm; Potassium (K) of 13.29 ppm. On the contrary, Cation Exchange Capacity (CEC) level was high (85.94 ppm). The soil acidity was caused by the dissolved organic acid due to organic matter decomposition. The low availability of Pinpeat soils was due to in ability of peat soils to absorb P that most of P was washed out before being absorbed by plants. In addition, micro elements such as Cu and Zn were also low in concentration. The application of Dolomite or Zeolite amendments of 2.5t/ha for 3 weeks incubation showed to increase the soil acidity to 6.55 and 6.7, respectively.

3.1. Plant growth

Table 1. Effect of amendment and NPK fertilizer on the plant growth and chlorophyll

Parameter	Amendments		NPK Fertilization (g/tan)			
	Dolomit	Zeolit	0	1.5	3.0	4.5
Plant height (cm)	86.67	86.33	81.33	78.50	95.83	90.33
Number of leaves	198.8	205.2	177.5	179.3	235.2	216.0
Leaf area (mm)	3.799	3.884	3.843	3.929	3.951	3.643
Root/Shoot	0.495	0.460	0.48	0.48	0.49	0.46
Root volume (cm^3)	72.50	69.25	61.67^{c}	67.50^{b}	76.83^{a}	77.50^{a}
Chlorophyll	25.53^{B}	29.00^{A}	26.32^{c}	26.17^{c}	27.76^{b}	28.83^{a}

$^{A,B,\ a,b,c}$ Numbers with the different notation on the same row showed significant difference.

All treatments did not significantly affect growth except the treatment of NPK fertilizer dosage against root volume and chlorophyll. Amendment treatment and fertilizing dose significantly affected the chlorophyll level. The use of zeolite added to fertilization can increase the efficiency of nitrogen release being available [6]. NPK doses up to 4.5 g / plant can increase chlorophyll levels higher than lower doses.

Nitrogen (N), a constituent of chlorophyll, proteins and other molecules, is very important for plant growth. Therefore, its availability affects the yield and quality of agricultural and horticultural crops.

Because nitrogen is the nutrient that most often limits plant growth, N fertilizer is used to overcome this limitation and increase crop production [7]. Zeolite has a significant effect on the percentage of chlorophyll, this shows that the use of zeolite can increase the efficiency of NPK fertilizer by controlling nitrogen washing. Zeolites promote nitrification of nitrogen in the soil and significantly reduce the nitrate content in Plants [2].

Fertilization treatment has a significant effect on root volume and vice versa in the Root shoot ratio. This shows that fertilization treatment is more widely used for root growth. Fertilizers with a dose of 3.0 g / plant and 4.5 g/plant can increase growth compared to lower doses.

In general, the treatment of zeolite showed a better effect than dolomite on the growth of *P. aleaceae*. Calcification has been shown to reduce the amount of P fertilizer needed to increase yield in some soils. This reduction in P requirements results directly from increased P soil solubilization and subsequent uptake and / or indirect increase in P uptake due to reduced Al and Mn toxicity [8]. Nanthi et al, [9] although Zeolite has advantages in the ability to maintain moisture in the soil, and maintain it for a long time so that it is very helpful in absorbing nutrients for plants.

3.2. Nutrient uptake

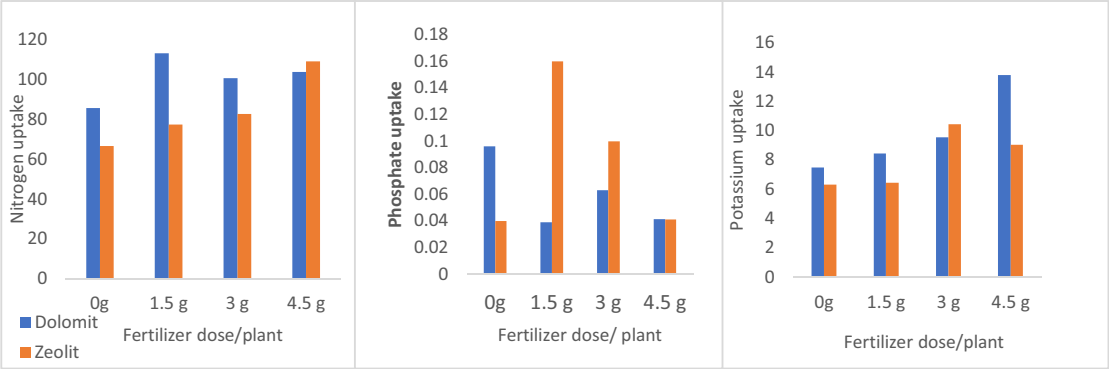

Figure 1. The effect of amendments and NPK fertilization on nutrient uptake

All treatments have not been able to significantly increase nutrient uptake. The age of 3 months harvesting is not enough to increase absorption significantly, but the numbers show that amendment and fertilization increase NPK nutrient uptake. Except for P absorption because the available P content of peat soil is very low.

The important physical properties of peat are high porosity [10] and very high-water content. Therefore, peat is natural under anaerobic conditions. Because peat material has irreversible drying properties, the function of peat as a hydrological controller will be easily disturbed. In anaerobic conditions, decomposition of organic matter in peat can actually occur even at very slow levels. Dolomite lime contains elements of Ca and Mg, where both types of elements through hydrolysis reactions can release OH- ions which affect the increase in soil pH. While Zeolite has the main components of silica and alumina in addition to micro elements, among others Na, K, Ca, Mg and Fe [11, 12]. Yuli et al. [13] states that liming on acid soil can increase the levels of N-NH4 +. This is a factor that cause plant N uptake can be increased by giving dolomite lime. The supply of dolomite lime can increase soil pH which will encourage the decomposition process of organic matter which produces organic phosphate compounds, which can be converted to phosphate and organically through a more perfect.

4. Conclusion

Dolomite and Zeolite 2.5 tons/ha amendment can neutralize the acidity of Rawa Pening peats Dolomite and Zeolite amendments 2.5 tons/ha and Nitrogen, Phosporus and Potassium fertilization with doses up to 4.0 g/plant can increase root/shoot, chlorophyll levels and nutrient uptake of Nitrogen, and Potassium.

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