RESEARCH ARTICLE

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Calcium and Iron Content of Aquatic Plants from Fresh, Brackish and Marine Water Environments and Their Potency to be Developed as Soil Conditioner

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Calcium and Iron were important component in plants. Their availability in aquatic plants was investigated. As some macrophyte are under utilized, we promote their uses for soil conditioner. To be used in that kind of matter, it is necessary to assess their nutrient content, such as calcium and iron. Their high content of calcium and iron can be used as recommendation for soil conditioner to rehabilitate marginal land. Some macrophyte collected from fresh, brackish and marine water was brought to laboratory for their mineral content analysis. Calcium and iron content were analyze using Atomic Absorbtion Spectofotometer (AAS). This study resulted that there are high variation of calcium and iron content among aquatic specieses and their environment. In general, calcium content in each species was higher compared to Iron. Calcium content tends to increase from fresh to marine water, while iron content tends to decrease. The highest content of calcium was provided by marine macrophyte, *Sargassum polycistum*, while highest of iron was provided by fresh water macrophyte, *Euchornia crassipes*. These two aquatic plant species are best candidate to be used as soil conditioner in land lack of calcium and iron.

Keywords: Aquatic Plant, Calcium, Iron, Soil Conditioner.

1. INTRODUCTION

Calcium is an essential plant nutrient. It is required for various structural roles in the cell wall and membranes.[1] Calcium addition will increase cell wall strength and thickness.[2] According to America Society of Biologist, calcium play an important role for plant growth and development.[3] Beside calcium, Iron also play an important role to support plant growth.[4] This type of heavy metals is essential for plant and animal growth.[5] According to Iskandari (2011), almost a third of soil in entire world is lack of iron.[6] Aquatic plants, such as seaweeds, contain almost 60 trace element and mineral.[7] Some seaweeds were known to have high level of calcium and iron.[8] Some aquatic macrophyte are also valuable as they have high content of calcium and iron.[9] As seaweeds also contain high amount of macro and micronutrient, they have recently used as foliar spray for various crops.[10] Analyzing and comparing of calcium and iron content from different species of aquatic plant collected from different environment is important to be used as reference for soil conditioner. Some soil, particularly marginal soil, required additional treatment to obtain better condition to support plant growth and development.

2. EXPERIMENTAL DETAILS

Different species of aquatic plants were collected from different location. There were three type of location, including fresh water, brackish water and marine water. Fresh water aquatic plants were collected from Rawa Pening Lake, brackish water aquatic plants were collected from shrimp pond around northern coastal area of Central java, while marine aquatic plant were collected from Jepara Sea, Central Java. Different species of fresh water aquatic plants including *Eichornia crassipes, Hydrilla verticillata, Salvinia molesta* and *Lemna* sp. Brackish water aquatic species including *Chaetamorpha, Najas minor* and *Ruppia maritima*, while collected marine aquatic plants were *Eucheuma spinosum, Eucheuma cottonii, Sargassum* sp. and *Gracilayingria verrucosa*. Collected aquatic plants were washed trhoughly, followed by under sun drying. Dried aquatic plants were brought to laboratorium and grounded into powder. Each powder was weighed for preparation to be destructed. Destructed sample was analyze for calcium and iron content using Atomic Absorbtion Spectrophotometer (AAS). Atomic absorption for calcium was detected at wavelength of 442,7 nm while iron was detected at wavelength of 248,3 nm.

3. RESULTS AND DISCUSSION

3.1. Calcium and Iron Content of Fresh Water Aquatic Plants

Calcium content of fresh water aquatic plant were ranged from 225 mg/g to 452 mg/g dry weight, whereas iron content were ranged from 184 mg/g to 402 mg/g of dry weight. Calcium content in Lemna was the highest while iron content was the least. On the other, calcium content of *Euchornia* was the least, but the iron content was the highest. In another words, *Euchornia* was rich in iron while *Lemna* was rich in calcium. Calcium and iron content in Hydrilla was almost balance between 241 mg/g of calcium and 284 mg/g of iron. The iron content of *Hydrilla* was slightly higher than calcium. On the other hand, Salvinia contain slightly higher calcium than iron. According Leng,[10] duckweed appear to be able to concentrate many macro and micro minerals several hundred fold from water.[10] Calcium content in duckweeds was more than twice of iron content.[10] Calcium and iron content of four species of fresh water aquatic plant is illustrated in Figure 1. This research showed that, Lemna with its high content of calcium has high potential to be used as soil conditioner to particularly enrich acid soil. According to cid soils occupy almost 30% of the world's land area.[11] Numerous factors can result in soil acidification, such as large inputs of inorganic fertilizers, high rainfall, acid deposition and greenhouse gas. As the concentration of H^+ in the soil increases, it can inhibit root growth[12] and disrupt the functions of cell wall.[13] Deficient levels of calcium, magnesium and phosphorus (P) are also frequent under low pH conditions.[14]

3.2. Calcium and Iron Content of Brackish Water Aquatic Plants

From the brackish water aquatic plants, we evaluate calcium and iron content of three different species, *Chaetomorpha*, *Najas minor* and *Ruppia maritima. Chaetomorpha* is species that contain very high of calcium. Its calcium contains reached approximately 856 ppm, followed respectively by *Najas minor* (156 ppm) and *Ruppia maritima* (103 ppm). Iron content in *Ruppia minima* was the highest, it was 169 ppm, followed respectively by Chaetomorpha (116 ppm) and *Najas minor* (88 ppm). Calcium and iron content of three species of brackish water aqutic plant is illustrated in Figure 2.

3.3. Calcium and Iron Content of Marine Water Aquatic Plants

In comparing to fresh water and brackish water aquatic plant, marine aquatic plant contain higher concentration of calcium. We evaluate calcium and iron content among four different species of marine aquatic plant, *Eucheuma spinosum*, *Eucheuma cottonii, Sargassum polycistum* and *Gracilaria verrucosa.* Amount them, *Sargassum* is species that contain highest calcium compared to other species. Its calcium contain reach to 1130 ppm, followed respectively by *Gracilaria verrucosa* (480 ppm), *Eucheuma*

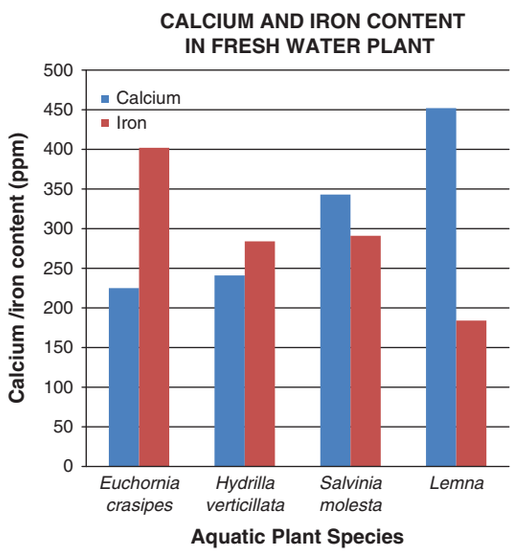

Fig. 1. Comparison of calcium and iron content of four species of fresh water aquatic plant.

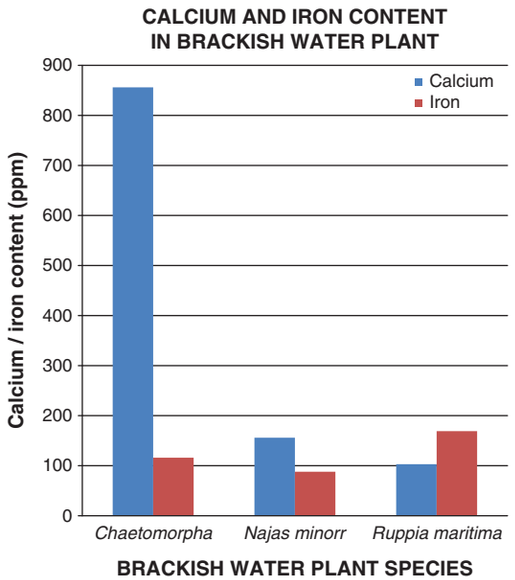

Fig. 2. Comparison of calcium and iron content among brackish water aquatic plants species.

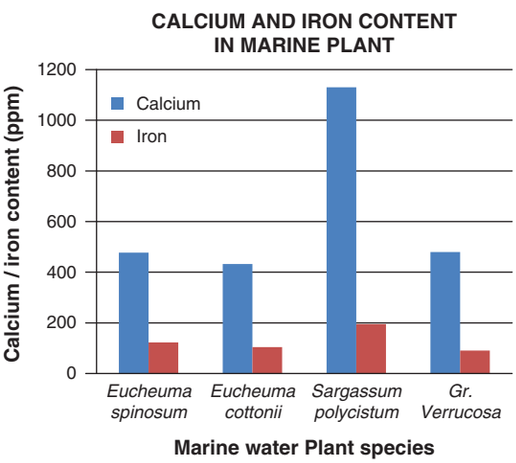

Fig. 3. Comparison of calcium and iron content among brackish water aquatic plants species.

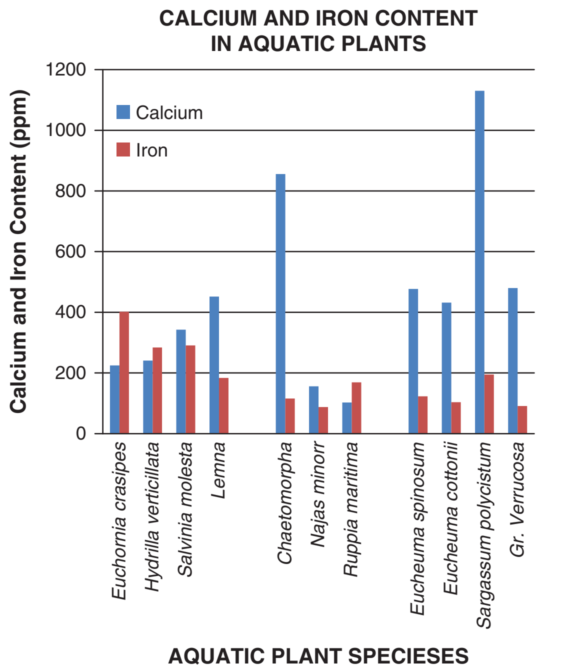

Fig. 4. Comparison of calcium and iron content of aquatic plant among different location.

spinosum (477 ppm, and *Eucheum cottonii* (432 ppm). However, their iron contain in marine aquatic plants are relatively low compared to aquatic plant from fresh or brackish water. Among these four species, the iron content of *Sargassum* was the highest, it reach to 195 ppm, followed respectively by *Eucheumaspinosum* (123 ppm), *Eucheuma cottonii* (104 ppm) and *Gracilaria verrucosa* (91 ppm). Calcium and iron content of four species of mariner aquatic plant is illustrated in Figure 3.

Marine aquatic plant or seaweeds have been known as source of mineral.[15] We found in this research that *Sargassum* is brown seaweeds species that contain highest value of calcium and iron. According to Nazni and Renuga,[16] *Sargassum* has shown contain highest mineral compare to other brown seaweeds species.[16] The high contain of calcium and iron in Sargassum make this species more appropriate to be developed as soil conditioner. Research by Yasmin et al.,[17] indicated that using *Sargassum* for soil conditioner increase the growth of legume almost twice than without it.[17] Soil conditioner usually play an important role as nutrient supplier and also repair some soil physical condition.[9] From overall this research indicated that there is a trend in which different location source of aquatic plant give a different results in calcium and iron contain. Marine aquatic plants are a good resource of calcium, while fresh water aquatic plants is a good resource of iron. Brackish water aquatic plant shown medium level of calcium and iron contain compared to plants from fresh and marine water.

3.4. Comparison Among Source of Location

If we compare of calcium and iron content among different source of location, it is indicated that aquatic plants taken from fresh water tend to have more iron content than plant species from two other location. On the other hand, marine aquatic plants tend to have higher calcium content compare to aquatic plant collected from two other site of location. Aquatic plant collected from brackish water have medium content of either calcium or iron. The trend of calcium and iron content among aquatic plant species from different location is shown in Figure 4 as followed: from this research, it is suggested that aquatic plants from fresh water is appropriately applied to enrich soil with lack of iron, while marine aquatic plants is the best to be applied for acid soil.

4. CONCLUSION

This research show a trend in calcium and iron contain among different source location of aquatic plants. Plants from marine rich in calcium, while from fresh water is rich in iron. Among fresh water aquatic plants, the species that richest in iron was *Eichornia crassipes*, while among marine plants, species that richest in calcium was *Sargassum*. It is recommended that *Sargassum* is the right species to be used as soil conditioner and applicable for acid soil. On the other hand, *Euchornia crassipes* is the best choice as soil conditioner to be used on soil with lack of iron.

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