

The Use of Seaweeds *Sargassum Sp* and *Gracilaria Verrucosa* as Soil Conditioner to Enhance The Growth of *Vigna Radiata* in Sandy and Clay Soil

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Abstract. Seaweeds have been known to have some beneficial impact in enhancing the growth of agricultural plant. We investigate the use of *Sargassum sp.* and *Gracilaria verrucosa* in enhancing the growth of *Vigna radiata*. The seaweeds were collected from Awur bay and shrimp pond in Jepara and Kendal, Central Java. The seaweeds was dried and soaked to reduce salinity, then dried again under the sun. The dried seaweeds were then finely powdered, and applied into sandy and clay soil at the proportion of soil conditioner: soil medium was 1:4. After 4 weeks composting, the mixed medium were used to plant the *Vigna radiata* seed. The growth of *Vigna radiata* was monitored by the height of the plant weekly. The collected data was analyzed using t test to compare before and after the use of seaweeds soil conditioner in certain type of soil. Results indicated that in sandy soil, *Gracilaria* was capable in increasing the growth of *Vigna radiata* by 23.86% ($p=0.005$). Whereas *Sargassum sp* increase the growth of *Vigna radiata* by 37% ($p=0.002$).

Keywords: *Sargassum*, *Gracilaria*, soil conditioner, *Vigna radiata*.

Introduction

A soil conditioner is a product which is added to [soil](#) to improve the soil's physical qualities, especially its ability to provide nutrition for plants. The treatment with soil conditioner was used to counter the increase of using a high amount of chemical fertilizer that deteriorates soil health (Khan and Qasim, 2008). Soil conditioner also is expected to contribute in providing water reservoir in the soil (Vijayalakshmi, 2012). Soil water is required to develop root stem in upper layer. This type of soil conditioner has been tested to increase fertility of sandy soil (Silberbush *et al.*, 1993). The water stored in this way is available to plants as sandy particle bonded to the hydro gel molecules and improvement of soil structure (Vijayalakshmi, 2012). There is a long history of coastal people using seaweeds, especially the large brown seaweeds, to fertilize nearby land. Traditionally, coastal communities worldwide have been using drift seaweed as soil amendment and fertilizer (Rebours *et al.*, 2014). Sandy soil is a type of soil that has a low of water holding capacity. Water infiltration in sandy soil is very high due to higher size of soil pores. Hydro gels has been proved to improve water holding capacity in sandy soil (Taylor and Hafacre, 1086; Bay *et al.*, 2011). The aim of this research is to

improve the growth of *Vigna radiata* in marginal soil by addition of seaweeds powder from *Sargassum sp* and *Gracilaria verrucosa*.

Materials and Methods

The materials used in this experiment were *Sargassum* and *Gracilaria* dry powder, sandy and clay soil, plastic pots, and *Vigna radiata* seeds. The methods of this study were started by collection of fresh *Sargassum* seaweeds from Jepara Sea, while *Gracilaria* was collected from brackish water around Kendal district, Central Java. The collected seaweeds were then dry under the sun, and reach their constant level of weight. This is indicated that the water content was all dried out already. The dried seaweed was grounded into powder, and later will be used as soil conditioner in two type of unproductive soil, i.e.: sandy and clay soil. As much as 50% of soil was replaced by these two seaweeds powder as treatments. The sandy and clay soil that been already mixed with seaweeds powder then put into plastic pots. Into each plastic pots. *Vigna radiata* seeds were planted to grow. Two maintain their growth level, watering was applied every single day. The growth rate of *Vigna radiata* were weekly monitored for their increased in shoot length. Collected data was

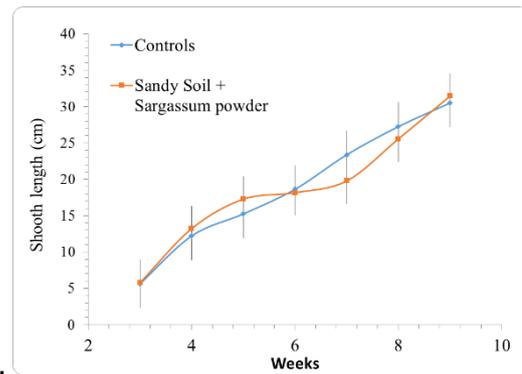
analyzed using Anova for single factor, continued by Duncan test.

Results and Discussion

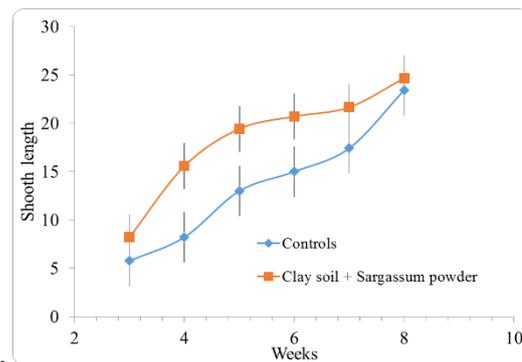
Effect of *Sargassum* powder as soil conditioner on growth of *Vigna radiata*

The addition of *Sargassum* powder on sandy soil has no significant effect on the growth of *Vigna radiata*. However, in clay soil the presence of this soil conditioner is highly significant in increasing the growth of *Vigna radiata*. In sandy soil, the final shoot length of *Vigna radiata* is similar in both treatments. In clay soil, the shoot length of *Vigna radiata* was almost twice if treated with soil conditioner from *Sargassum* powder. According to Prakash and Nikhil (2014), soil conditioner is actually prepared to nourish soil in helping the growth of various plants. The increase of soil fertility by application of soil conditioner is not only due to their chemical content to improve soil nutrition but also improving soil physical performance, such as, water holding capacity and also soil aeration. Sandy soil has less water holding capacity, but more aeration to capture oxygen for the cell respiration. In contrast, clay soil has higher water holding capacity but less aeration. The addition of soil conditioner is attempted to improve soil physical property in order to serve a better plant growth. Indonesian *Sargassum* approximately contains 38% of alginate (Handayani et al., 2004). Alginate is a hydro gel that responsible in improving water holding capacity in soil. According to Kartini and Kartikaningsih (2013), fiber content in *Sargassum* is also high, and reaches to 33.6766%. The high content of fiber may responsible for increasing aeration in the soil, as this component will able to provide a large amount of macro pores in the soil.

Clay soil is a type of soil that has a less amount of macro pores, hence the aeration is also lower. In consequence, the availability of oxygen is also small. In this case, the cell respiration in root system will be reduced, and the growth activity will be diminished. The addition of *Sargassum* powder that assumed to contain high amount of fiber will capable in increasing the amount of macro pores, therefore the aeration will also increase.



a.



b.

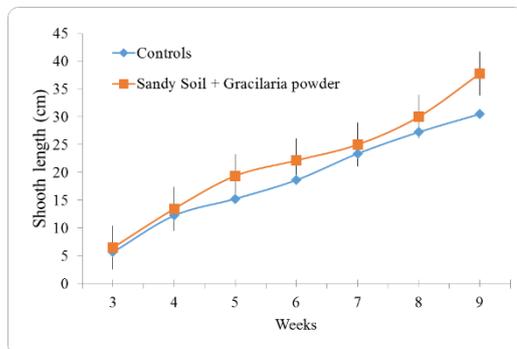
Fig A-B: Effect of *Sargassum* powder n as soil conditioner on growth of *Vigna radiata* (A= on Sandy soil. B= On Clay soil)

This condition will help in providing enough oxygen level in clay soil, and resulted in higher growth rate of plants. In this study, indicated by the increase growth of *Vigna radiata* in clay soil by addition of *Sargassum* powder.

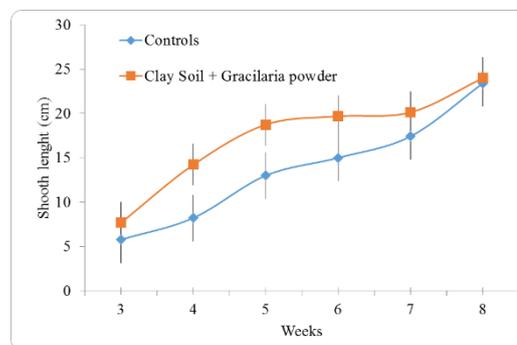
Effect of *Gracilaria* powder as soil conditioner on growth of *Vigna radiata*

In this research, we found that addition of *Gracilaria* was capable in increasing the growth of *Vigna radiata* in sandy soil by 7%. Whereas, in clay soil there was no effect of adding *Gracilaria* powder on *Vigna radiata* growth. *Gracilaria* and *Sargassum* were both seaweeds, but they have different chemical and physical properties in helping soil fertility. A preliminary study of agar content and strength on *Gracilaria* by Ahmad et al. (2011), indicated that in average of *Gracilaria* contain about 10% of agar from their dry weight. In Indonesia, *Gracilaria* contain agar in a range of 3.7 -4.22 % of dry weight (Trawanda et al., 2014). Seaweeds capable in retaining water and supply essential nutrients to the soil which is required for the proper growth of a plant. This water holding capacity of seaweeds is determined by agar

content. Agar is hydro gel that capable in retaining water. According to Gibas and Janik (2010), dried hydro gels can absorb water up to 1000 times their own weight. It may answer the reason in increasing plant growth in sandy soil after application of seaweeds containing agar as soil conditioner.



a.



b.

Fig C-D: Effect of *Gracilaria* powder as soil conditioner on growth of *Vigna radiate* (A= on sandy soil. B= on clay soil)

It has been tried through various research, algae is utilized as soil conditioner and effectively increase cereals crops due to improvement of nutrient uptake, and pest resistant (Prakash and Nikhil, 2014). It suggested that application of seaweeds as soil conditioner should consider species specific chemical content to provide better plant growth according to soil characteristic.

Conclusions

It can be concluded that addition of Seaweeds powder, *Gracilaria verrucosa* and *Sargassum* sp. were capable in increasing the growth of *Vigna radiata* in sandy and clay soil. Application of *Sargassum* has significant effect on clay soil and *Gracilaria* addition on sandy soil slightly increase the growth of *vigna radiata*. This two different effect might

be caused by their different in chemical content dominated in every different seaweeds species.

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