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The Evidence Suggesting that *Turbinaria murayana* Extract Induce Remobilization of Macromolecule from Leave to Grain of Rice Plants

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Abstract. Brown algae is known to produce several phytohormons. Therefore, it could be develop as an important biostimulant for growth of agriculture and horticultural plants. Action of biostimulant depends on optimal time of application. This article report growth and yield of rice plant supplied with liquid extract of several species of brown algae, either during vegetative or generative growth. The treathment influenced variably growth and yield of rice plants. Liquid extract of *Sargassum crassifolium* and *Sargassum polycistum* did not influenced growth and yield of rice plants, either supplied in combination with *Turbinaria murayana* extract or not during generative growth. However, application *Sargassum cristaefolium* and mixed extract consistenly effected growth and yield of rice plants. Application of *Sargassum cristaefolium* extract increased shoot dry weight, appoximately 94,70% higher than of control. In contrast, when this plants sprayed with *Turbinaria murayana* extract during generative growth reduced shoot dry weight, approximately 25% than those sprayed only with *Sargassum cristaefolium* during vegetative growth. Since the plants supplied with *Sargassum cristaefolium* during vegetative growth in combination with *Turbinaria murayana* during generative growth, induced grain weight of rice plants, this suggest that application of *Turbinaria murayana* extract induced remonbilization of macromolecules such carbohydrate and protein from leave to the grain of rice.

INTRODUCTION

Application of inorganic fertilizer has many disadvantages, such as decreased soil fertility and harmful for the environment. Moreover, it induces vegetative growth and it delays generative growth. Therefore, it reduces yield of plants including rice [1]. Based on this condition, then it is required organic biostimulant and biofertilizer which could induce vegetative growth which ultimately improve remobilization of macromolecules from leaf to penicle and grain during generative growth. As result of this, deposition of macromolecule to the grain increase, then the yield will be increase as well.

Macroalgae is well known as source of organic biosimultant and biofertilizer [2]. Therefore, many authors report that it stimulates germination [3], seedling [4], growth and production of several species, such as tomato plants [5], maize [6,7,8], vegetable [5], soybean [9] rice [10], and cucumber [11].

Those all article report the effect macroalgae's extract on germination, seedling, growth and production of plants. However, the article do not explain the effect of extract on remobilization and deposition of reverse molecule to fruit and seed inducing yield of the rice plants. This article report the evidence *Turbinaria murayana* extract suggesting remobilization of macromolecule from leaf to grain of rice plants. *Turbinaria murayana* extract sprayed to the plants which were already supplied with *Sargassum cristafolium* or mixture brown algae during vegetative growth, induced growth and yield of rice plants. This indicates that this treatment induce remobilization and deposition of reserve molecule from leaf to the grain of rice plants. Therefore, *Turbinaria murayana* extract could be developed as organis biosimultant which could induces remobilization of molecule to grain, which ultimately increase yield of plants.

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MATERIAL AND METHOD

Design Experiment

Experiment was design by completely randomized design in plastic house in Jatisela West Lombok. Experiment consisted of two factors. First spraying in vegetative growth with Vo, control, V_1, *Sargassum crassifolium*, V_2, *Sargassum cristafolium,* V_3, *Sargassum polysistum,* V_4, mixture brownl algae. Second, spraying in generative growth with Go, control, G_1, *Turbinaria murayana.* There were eight combinations, and each combination was three reprilicates. Therefore there were 24 experimental pots. Growth parameters such as plant heigh (cm), tilles number, shoot dry weight (gr) and root dry weight (gr), were measured during harvesting time. In addition, yield parameters, like penicle number and grain weight (gr), were also measured during harvesting time. The dates are expressed as mean of three replicates ± SD.

Sample Collection and Extraction

Seaweed samples were collected in Batu Layar coastel beach area West Lombok, rinsed and dried in shadow place for three days. Samples were cutted into small pieces. Each samples (1 kg) was placed in 5L flask chemical glass [12]. The water 3L was added into the and its were homogenized. After that, homogenized samples boiled in 95ºC water bath for 30 minutes. Then it was filtered using whatman filter papper no 1. Supernatant obtained was called as 100% liquid extract.

Preparation of Seedling and Growth Media

Rice seeds were sown in media containing soil and sand with comparison 3 : 1. The seeds were leave to grow until three weeks. After that, the seedings were ready to be planted.

Growth media consisted of 6 kg soil and 1 kg organic fertilizer. They were mixed into homogen. Then, its were added water until saturated. Then, the media were leave overnight before they were planted.

Planting and Spraying Liquid Extract

Seedlings were transplanted in growth media that were already prepared. Then, they were left to grow until harvesting time. Except treatments, the plants were maintained according to recommendation to grow rice plants.

One week after planting, liquid extract (10%) of *Sargassum crassifolium, Sargassum cristafolium, Sargassum polysistum,* or mixture of brown algae were sprayed. The spraying with those extract, was conducted once a aweek during vegetative growth. On the other hand, spraying (10%) of *Turbinaria murayana* liquid extract were spraied during generative growth.

RESULT AND DISCUSSION

Plant height was response differently to the spraying time of each species of brown algae (Table 1). Except liquid extract of *Sargassum cristafolium,* other brown algae liquid extract, like *Sargassum crassifolium, Sargassum polysistum* and mixture liquid brown algae, did not influence plant height. The plant produced by these treatment were shorter than control plants (Table 1). However, liquid extract of *Sargassum cristafolium* increased plant height of rice plant.

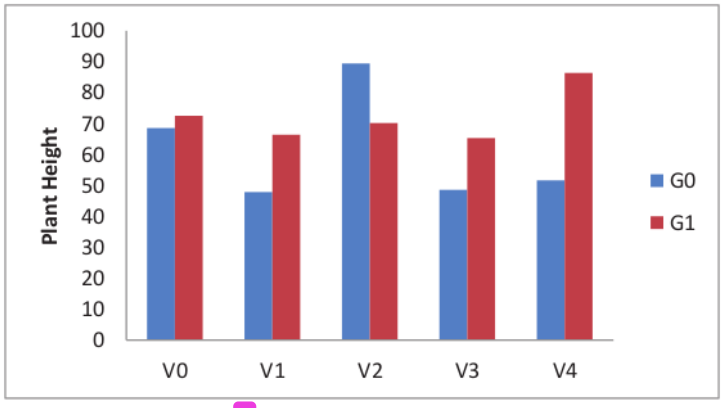

FIGURE 1. Effect of spraying time of liquid extract of brown algae on plant height (cm) of rice plants.

This indicator that liquid extract of *Sargassum cristafolium* contain hormones that could induce cell division and growth of rice plants. This phenomena was also reported occure in several species, like eggplant (*Solanum melongena*) [5] and tomato (*Lycopercisum esculentum*) [5].

Except liquid extract of *Sargassum cristafolium*, spraying liquid extract of *Turbinaria murayana* to the plants sprayed with liquid extract of *Sargassum,* tend to increase plant height. However, for the plants sprayed with liquid extract of *Sargassum cristafolium* during vegetative growth, spraying liquid extract of *Turbinaria murayana* reduced plant height. This indicates that *Sargassum cristafolium* contain to induce growth, and on the other hand Turbinaria contain phytohormone inhibiting growth as documented in Literature [13].

Effect of spraying time of brown algae liquid extract on filler number is shown in figure 2.

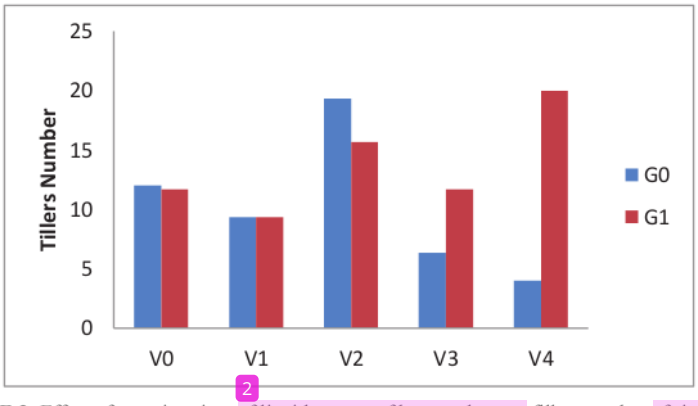

FIGURE 2. Effect of spraying time of liquid extract of brown algae on filler number of rice plants.

The data in figure 2 shown that the spraying of *Sargassum crassifolium,* and *Sargassum polysistum* during vegetative growth followed by spraying of *Turbinaria murayana* liquid extract during generative growth, did not affect filler number of rice plants. However, spraying *Sargassum cristafolium* liquid extract of *Turbinaria murayana,* then it decreased filler number of rice plants. This indicates that mixture hormone from two algae inhibits growth of plants.

In contrast, it was occurred something different in the plants were sprayed with *Sargassum polysistum* and mixture brown algae during vegetative which were continued to spray with liquid of *Turbinaria murayana* extract during generative growth (Figure 2). The application of these two treatment tend to increase filler number. This is

due to composition and amount of phytohormones could increase filler number, as it is also occurs in other plants [14].

Except effect of liquid extract of *Sargassum cristafolium* in combination with *Turbinaria murayana,* other liquid extract of Sargassum tended to increase shoot dry weight when the plants were also sprayed with liquid extract of *Turbinaria murayana* (Figure 3). The combination of liquid extract of *Sargassum crassifolium,* and *Sargasuum polysistum* in combination with liquid extract of *Turbinaria murayana* did not affect shoot dry weight of rice plants. However, combination of *Sargassum cristafolium* plus *Turbinaria murayana,* and liquid extract of mixture Saargassum plus *Turbinaria murayana* influenced the shoot system of rice plants.

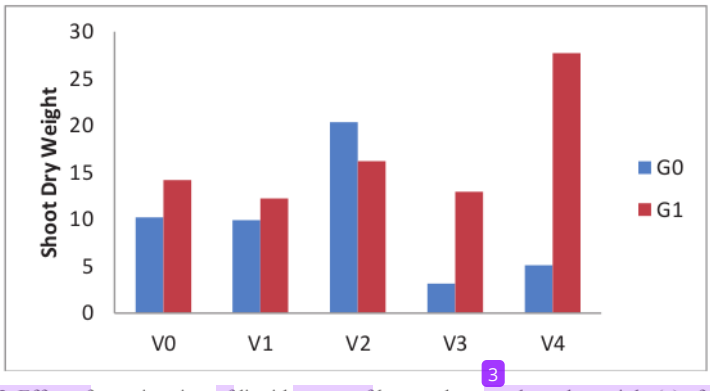

FIGURE 3. Effect of spraying time of liquid extract of brown algae on shoot dry weight (g) of rice plants.

Application of liquid extract of *Sargassum cristafolium* during vegetative growth increased shoot dry weight. However, when this plant also sprayed with liquid extract of *Turbinaria murayana* during generative growth, reduce shoot dry weight of rice plants. In contrast with that fact, liquid mixture extract had very low effect on shoot dry weight. However, when this plants were also sprayed with liquid extract of *Turbinaria murayana* increased shoot dry weight significantly to the level of highest shoot dry weight.

Similar phenomena was also occurred in response in root dry (Figure 4). In control plants, application of *Turbinaria murayana* liquid extract decreased root dry weight. Application of liquid extract of *Sargassum crassifolium* or *Sargassum polysistum* during vegetative growth and liquid extract of *Turbinaria murayana* during generative growth did not effect dry weight of root system.

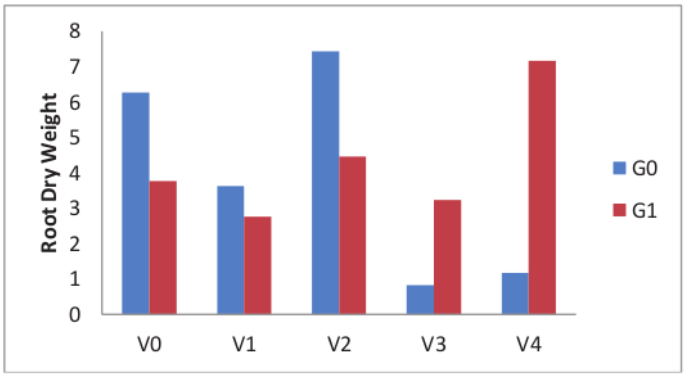

FIGURE 4. Effect of spraying time of liquid extract of brown algae on root dry weight (g) of rice plants.

However, application of *Sargassum cristafolium* or liquid extract of mixture brown algae affected dry weight of root system. Application of *Turbinaria murayana* during generative growth to the plants sprayed with liquid extract of *Sargassum cristafolium* or mixture of brown algae increased root dry weight.

Three type response of root system to liquid extract sprayed during vegetative and generative growth. Firstly, application of liquid extract of *Turbinaria murayana* during generative growth inhibited growth of root system. This indicates that liquid extract of *Turbinaria murayana* contain phytohormone inhibiting growth of root system. Seemdily, spraying liquid extract of *Turbinaria murayana* to the plants supplied with *Sargassum polysistum* increased growth of root system to the level below control plants.

This indicates that phytohormone in the liquid has small activity on the plants sprayed with *Sargassum polysistum* during vegetative growth. This phenomena was also reported in other plants, like green beans (Vigna radiate) [15], black gram (*Vigna mungo)* [15] and pigeon pea (*Cajanus cajan*) [16]. Thirdly, the application of liquid extract of *Turbinaria murayana* to the plants that already sprayed with mixture of brown algae during vegetative growth increased growth of root dry weight. This phenomena indicates that phytohormone in liquid extract of mixture brown algae stimulates the growth of root system. Effect of application time of liquid extract on yield parameters, such as penicle number and grain weight, is shown in figure 5 and figure 6 respectively.

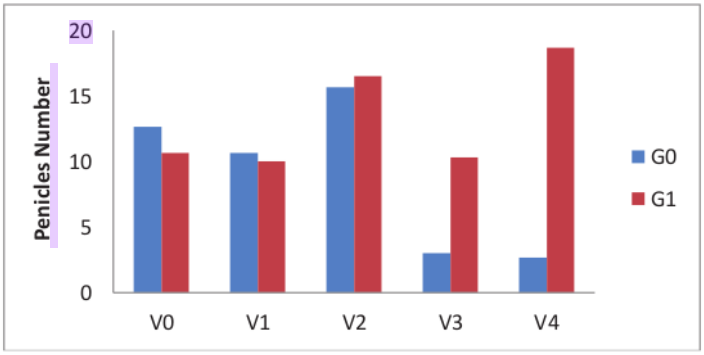

FIGURE 5. Effect of spraying time of liquid extract of brown algae on penicle number of rice plants.

As response of vegetative growth, response of generative was similar. The application of liquid extract of *Turbinaria murayana* on the plants that were already sprayed with *Sargassum crassifolium* or *Sargassum polysistum,* did not effect penicle numbr. However, the application of *Turbinaria murayana* liquid extract on the plants sprayed with liquid extract of *Sargassum cristafolium* or mixture brown algae, increased penicle number.in the first group of plants, which were sprayed with liquid extract of *Sargassum crassifolium* or *Sargassum polysistum* during vegetative growth, then the application of liquid extract of *Turbinaria murayana* did not has enough amount of phytohormone to stimulate remobilization of macromolecule from leaves to penicle. On the other hand, spraying liquid extract of *Turbinaria murayana* to the plants sprayed with liquid extract *Sargassum cristafolium* or *Sargassum polysistum* has enough phytohormone to remobilize macromolecule from leaf to penicle. This argument has already documented in many literatures [17].

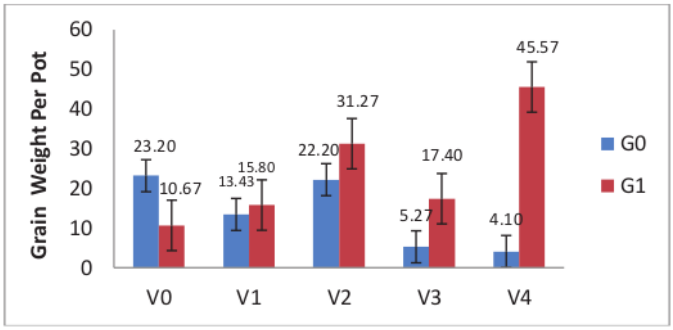

FIGURE 6. Effect of spraying time of liquid extract of brown algae on grain weight of rice plants.

Similar phenomena was also found in grain weight response (Figure 6). In the rice plants those were already sprayed with liquid extract of *Sargassum crassifolium* or *Sargassum polysistum,* then the application of *Turbinaria murayana* extract during generative growth did not affect the grain weight of rice plants. In contrast, with the plants sprayed with *Sargassum critafolium* and mixture brown algae, the application of *Turbinaria murayana* liquid extract increased grain weight. These phenomena was similar with penicle number response. These indicate that phytohormone in liquid extract of *Sargassum crassifolium* or *Sargassum polysistum* in combination with phytohormone in liquid extract of *Turbinaria murayana,* is not enough to induce remobilization of macromolecule from leaf to penicle and to grain. In contrast to the plants sprayed with *Sargassum cristafolium* or mixture extract during vegetative growth, the spraying liquid extract of *Turbinaria murayana,* indicating that combination of phytohormone stimulates remobilization of macromolecule from leaf to penicle which is ultimately to grain. This process is already documented in literature [17].

CONCLUSION

Based on the above facts, it can be concluded that spraying *Sargassum cristafolium* or *Sargassum polysistum* , during vegetative growth either followed or not followed by spraying *Turbinaria murayana* extract, did not influence growth and yield of rice plants. However, the spraying liquid extract of *Sargassum cristafolium* or mixture brown algae during vegetative growth which were followed by applying *Turbinaria murayana* extract during generative growth influenced growth and yield of rice plants. This suggest that in there two treatments indicates that hormone contained in liquid extract induces remobilization of macromolecules in reserve leaf and deposited into the grain of rice plants.

ACKNOWLEDGMENTS

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