Application Of Seaweed Extract Sargassum Cristaeofolium And Amino Acid To Growth And Yield Of Upland Rice (Oryza Sativa L.)

Oza Sriyuni, Mansyurdin, Tesri Maideliza, Izmiarti, Zozy Aneloi Noli

Abstract: Sargassum cristaefolium was abundant marine resources on the west coastal of Sumatera and has the potential to be used as a biostimulant. Biostimulant was known as a natural organic compound that can promote plant growth, increase the absorption of nutrients, affect respiration, photosynthesis and increase leaf pigment. The aim of the study was to analyze the effect of seaweed extract S. cristaefolium added with some combination amino acid on growth and yield of upland rice (Oryza sativa L.) on Ultisol soil. This study used a completely randomized design with 5 treatments and 3 replications as the treatments: 1) S. cristaefolium + without amino acids, 2) S. cristaefolium + Glutamine, Alanine, Glycine (1.6%; 0.8%; 1.4%), 3) S. cristaefolium + Alanine, Glycine, Tryptophan (0.8%; 1.4%; 0.01%), 4) S. cristaefolium + Glutamine, Alanine, Tryptophan (1.6%; 0.8%; 0.01%) and 5) S. cristaefolium + Glutamine, Alanine, Glycine, Tryptophan (1.6%; 0.8%; 1.4%; 0.01%). The results showed that the application of S. cristaefolium added with combination amino acid have the potential to promote growth and yield of upland rice. Application of S. cristaefolium added with (Glutamine, Alanine, Glycine, Tryptophan) was recommended to increase yield of upland rice.

INTRODUCTION

Biostimulants were known as a natural organic compound in small amounts that can support plant growth, increase the efficiency of nutrient absorption, tolerance to stress, and improve crop quality [1]. Biostimulants affect several metabolic processes such as respiration, photosynthesis, ion uptake and increase leaf pigment [2,3]. Sources of biostimulant were humic acid, chitosan, fungi, beneficial bacteria and seaweed extract. Seaweed extract contains macromolecules, microelements, vitamins, fatty acids, amino acids, growth-regulating hormones such as auxin, cytokinin, gibberellins and abscisic acid [4,5,6]. Seaweed extract as biostimulant in plants could influence root growth and development, shoot growth, photosynthesis, increasing of plant vigor and delay fruit aging [7,8]. Moreover, seaweed extracts were biologically degradable, non-polluting and non-toxic for the environment [9]. According to [10] that extracts of Sargassum sp1, Sargassum sp2, Sargassum polycystum, Hydroclathrus sp, Turbinaria ornata and Turbinaria murayana were able to induce the growth of paddy and only Hydroclathrus sp could increase the growth and production of paddy. [11] reported that the application of 4g/l Ascyphophyllum nodosum's extract was given significant results in shoot fresh weight and the number of leaves in Lactuca sativa var. crispa. Application of 50% Cystoseira mediterranea's extract could increase the fresh weight of shoots and roots of Hordeum vulgare [12].

Some of the study results show the positive effects of seaweed extract combined with amino acids. Amino acids were the building blocks of protein and function in the process of metabolism, transportation and affect physiological activity in plant growth and development [5,13,14]. Amino acids could increase plant growth and productivity, increase chlorophyll a, chlorophyll b and improving tolerance to abiotic stress on plants [13]. According to [15] that the application of a combination of seaweed extract with amino acids could increase the height of Capsicum annuum plants. Phaseolus vulgaris treated with seaweed and amino acids have been reported a good influence on the growth and productivity of plants [16]. This study used upland rice as a tested plant. Rice is a food commodity that is a staple food for the Indonesian population. [17] reported that the productivity of national rice 5,236 tons/ha in 2016, while it decreased to 5,155 tons/ha in 2017. This is caused by a decrease in the area of rice fields due to the conversion of agricultural land for non-agricultural purposes and a decrease in soil fertility [18]. To overcome this problem, it is necessary to expand the strategy of food crops by using sub-optimal soil (Ultisol) to increase rice production in Indonesia [19]. According to [20] that Ultisol land has a distribution of nearly 25% of the total land area of Indonesia. The aim of the study was to analyze the effect of seaweed S. cristaefolium's extract added with some combination of amino acid on growth and yield of upland rice (Oryza sativa L.) on Ultisol.

1. MATERIALS AND METHODS

2.1 Experimental Design

The study was conducted in wirehouse and in the Plant Physiology Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences, Andalas University, from January to June 2019. The experimental design was conducted with a Completely Randomized Design (CRD) with the following treatments: 1) S. cristaefolium + without amino
2.2 Preparation of *S. cristaefolium*’s Extract

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Plant height (cm)</th>
<th>Fresh weight of shoot (g)</th>
<th>Dry weight of shoot (g)</th>
<th>Fresh weight of root (g)</th>
<th>Dry weight of root (g)</th>
<th>Flowering age (day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>80.67 a</td>
<td>181.46 a</td>
<td>42.34 a</td>
<td>70.57 ab</td>
<td>9.89 ab</td>
<td>84.33 ab</td>
</tr>
<tr>
<td>Amino acid 1</td>
<td>78.00 a</td>
<td>239.86 a</td>
<td>49.49 a</td>
<td>93.87 b</td>
<td>15.97 b</td>
<td>83.00 a</td>
</tr>
<tr>
<td>Amino acid 2</td>
<td>79.17 a</td>
<td>187.89 a</td>
<td>46.49 a</td>
<td>64.88 a</td>
<td>11.79 b</td>
<td>83.00 a</td>
</tr>
<tr>
<td>Amino acid 3</td>
<td>81.83 a</td>
<td>179.39 a</td>
<td>44.66 a</td>
<td>63.80 a</td>
<td>10.21 b</td>
<td>84.00 ab</td>
</tr>
<tr>
<td>Amino acid 4</td>
<td>81.00 a</td>
<td>190.48 a</td>
<td>45.33 a</td>
<td>52.45 a</td>
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</tr>
</tbody>
</table>

*S. cristaefolium* seaweed collected at Nirwana Beach, Padang City, West Sumatera. *S. cristaefolium* was cleaned to removed sand and other impurities, then transported to the Plant Physiology Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences, Andalas University. *S. cristaefolium* was cleaned again with running water and dried for four days. This dried seaweed was finely chopped to powder with a used grinder. Powder of *S. cristaefolium* was weighed according to treatment and immersed in hot water with a ratio (1:20 (w/v)). Then the extract was shaken for 24 hours and filtered. Finally, the filtrate was dissolved in 1 liter of water and put in a storage bottle [21].

2.3 Preparation of Amino Acids

Amino acids consist of Glutamine (1.6%), Alanine (0.8%), Glycine (1.4%) and Tryptophan (0.01%) were dissolved with distilled water. Amino acids were prepared according to treatment.

2.4 Application of *S. cristaefolium*’s Extract and Amino Acids

*S. cristaefolium*’s extract and amino acids were applied ± 25 ml per plant by spraying leaves evenly at 15 days after planting. Spraying was conducted in the morning [22].

2.5 Data Collection

Parameters measured of growth and yield were plant height, number of tillers, fresh weight and dry weight of shoot, fresh weight and dry weight of roots, leaf chlorophyll content, flowering age, number of productive tillers and weight of 100 grains.

2.6 Statistical Analysis

Data were examined using analysis of variance (ANOVA) and continued with Duncan New Multiple Range Test (DNMRT) at 5% level. Data were analyzed following the standard procedure using SPSS version 20.

### Table 1

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Plant height (cm)</th>
<th>Fresh weight of shoot (g)</th>
<th>Dry weight of shoot (g)</th>
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<td>85.33 b</td>
</tr>
</tbody>
</table>

*S. cristaefolium* was added with some combination amino acid on plant height, number of tillers, fresh weight and dry weight of shoot, fresh weight and dry weight of roots of upland rice.

3. RESULTS AND DISCUSSION

Application of *S. cristaefolium* seaweed added with amino acids given significantly different results on the fresh and dry weight of roots, chlorophyll a, chlorophyll b, total chlorophyll and flowering age of upland rice, but plant height, fresh weight and dry weight of shoot were not significant (Table 1 and Table 2). The treatment of *S. cristaefolium* seaweed added with amino acid 1 (Glutamine, Alanine, Glycine) showed the highest results in the fresh and dry weight of roots, chlorophyll a, chlorophyll b and total chlorophyll of upland rice. According to [23] that the interaction between seaweed 30% with amino acids 2 g/l significantly increases root wet weight, root dry weight and total chlorophyll in rosella plants (*Hibiscus sabdariffa*). The combination of 2 ml/l seaweed with 4 ml/l amino acids was able to increase the dry weight, chlorophyll a, chlorophyll b and total chlorophyll *Phaseolus vulgaris* plants [16]. Seaweed and amino acids can increase fresh weight and dry weight of roots, chlorophyll a, chlorophyll b and total chlorophyll. Seaweed contains macros and microelement components, amino acids, vitamins, auxins and cytokines that support plant growth activities [16]. These components affect cell metabolism thus increasing plant growth [15]. [24] reported that amino acids are protein precursors for stimulation of plant cell growth. Nitrogen compounds of the amino acid were improved plant growth. Also, amino acids play a role in biosynthetic hormones as precursors for the synthesis of auxins (IAA). Auxin was important in regulating the process of cell division and elongation [15]. According to [14] that Glutamine was very important to promote metabolic processes on plants. Alanine and Glycine were used to stimulate the formation of chlorophyll in plants. The fastest flowering age of upland rice was found in the treatment of *S. cristaefolium* added with amino acids 1 (Glutamine, Alanine, Glycine) and added with amino acids 2 (Alanine, Glycine, Tryptophan). Seaweed extract of *Ulva reticulata* sprayed at a concentration of 2% could accelerate the flowering age of *Vigna may*L. [25]. [26] reported that the application of the amino acid tryptophan 150 ppm could accelerate the flowering age of Amaryllis plants (*Hippeastrum vittatum*, Herb.).

Effect of *S. cristaefolium* added with some combination amino acid on plant height, number of tillers, fresh weight and dry weight of roots of upland rice.
Note: Values with common letter in the same column are not significantly different in the DNMRT test of 5% level.

Control (without amino acids); Amino acid 1 (Glutamine, Alanine, Glycine); Amino acid 2 (Alanine, Glycine, Tryptophan); Amino acid 3 (Glutamine, Alanine, Tryptophan); Amino acid 4 (Glutamine, Alanine, Glycine, Tryptophan)

### Table 2

Effect of *S. cristaefolium* added with some combination amino acid on chlorophyll a, chlorophyll b and total chlorophyll of upland rice

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Chlorophyll a (mg/l)</th>
<th>Chlorophyll b (mg/l)</th>
<th>Total chlorophyll (mg/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>1.10 b</td>
<td>1.62 b</td>
<td>2.74 b</td>
</tr>
<tr>
<td>Amino acid 1</td>
<td>1.22 c</td>
<td>2.09 d</td>
<td>3.31 d</td>
</tr>
<tr>
<td>Amino acid 2</td>
<td>1.19 c</td>
<td>1.89 c</td>
<td>3.08 c</td>
</tr>
<tr>
<td>Amino acid 3</td>
<td>1.03 ab</td>
<td>1.39 a</td>
<td>2.43 a</td>
</tr>
<tr>
<td>Amino acid 4</td>
<td>1.01 a</td>
<td>1.38 a</td>
<td>2.40 a</td>
</tr>
</tbody>
</table>

Note: Values with common letter in the same column are not significantly different in the DNMRT test of 5% level.

Control (without amino acids); Amino acid 1 (Glutamine, Alanine, Glycine); Amino acid 2 (Alanine, Glycine, Tryptophan); Amino acid 3 (Glutamine, Alanine, Tryptophan); Amino acid 4 (Glutamine, Alanine, Glycine, Tryptophan)

Figure 1 and 2 presented that the highest number of tillers and the number of productive tillers were the treatment of *S. cristaefolium* added with amino acids 1 (Glutamine, Alanine, Glycine). The number of productive tillers was related to the number of tillers and plant height. The number of tillers and the number of productive tillers were increased while the plant height will be lower [27,28]. [29] reported that productive tillers are tillers of rice which can produce panicles and showing rice production. The highest weight of 100 grains of upland rice was the treatment of *S. cristaefolium* added with amino acids 4 (Glutamine, Alanine, Glycine, Tryptophan) (Figure 3). [16] reported that the combination of seaweed extract 2 ml/l with amino acids 4 ml/l could increase the weight of 100 seeds on *Phaseolus vulgaris* plants. The application of tryptophan on the leaves of the *Chenopodium quinoa* plant could increase the weight of 1000 seeds by 45% compared with controls [30]. Seed weight was related to photosynthesis. The results of photosynthesis were stored in seeds so as to increase the weight of seed plants [29].

Fig 1. Number of tillers of upland rice by application of *S. cristaefolium* added with combination amino acid

![Fig 1. Number of tillers of upland rice by application of *S. cristaefolium* added with combination amino acid](image1.png)

Fig 2. Number of productive tillers of upland rice by application of *S. cristaefolium* added with combination amino acid

![Fig 2. Number of productive tillers of upland rice by application of *S. cristaefolium* added with combination amino acid](image2.png)

Fig 3. Weight of 100 grains of upland rice by application of *S. cristaefolium* added with combination amino acid

![Fig 3. Weight of 100 grains of upland rice by application of *S. cristaefolium* added with combination amino acid](image3.png)
4. CONCLUSION
The study showed that the application of S. cristaefolium added with (Glutamine, Alanine, Glycine) was recommended to increase the growth of upland rice. Application of S. cristaefolium added with (Glutamine, Alanine, Glycine, Tryptophan) was recommended to increase the yield of upland rice.

4. ACKNOWLEDGMENT
This article is part of research funded by Andalas University in 2018. The authors are thankful to the Rector and Chairman of Research and Community Service of Andalas University.

REFERENCES


