# The influence of fermented brown algae extract (*Sargassum* sp.) on corn plant growth (*Zea mays* L.)



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**Abstracts.** Brown Algae Extract is one of the ingredients used in organic fertilizers that is more effective for maximizing the growth and production of corn plants. This study aims to determine the effect of fermented brown algae extract on the growth of corn. The research was conducted in Sokkolia Field, Gowa District. The treatments were arranged in a randomized block design with 4 replications. The first treatment was algae extract which was inoculated by *Trichoderma harzianum* and *Gliocladium* sp. *Bacillus subtilis* and *Paenybacillus polymyxa as* well as unfermented algae extract. The algae extract was applied to corn by spraying. The parameters observed were plant height, stem circumference, cob length (cm), cob diameter, number of rows of seeds. The results showed that application of algae extract improved the quality and quantity of corn growth compared to the UPK (Urea + Phosphate + Potassium) control.

## 1. Introduction

Corn is one of the strategic commodities for humans and feeds for livestock consumption. During the last five years (2014-2018), it is estimated that Indonesian corn production grows by an average of 12.32 % per year [1]. Synthetic fertilizers can increase corn productivity. But, on the other hand, excessive and continuous use can disrupt the sustainability of the agricultural system; however, the continuous use of inorganic fertilizers in high dose will damage soils and the environment [2]. In addition, the application of these kinds of fertilizers also significantly affects human health, hygiene, air pollution, soil, water, and soil fertility, which triggers an increase of additional nutrients so that it has an extra cost on the agricultural production system.

One of the efficient methods based on environmentally friendly and sustainable nutrition sources is to utilize biofertilizers or organic fertilizers [3]. Sargassum sp. has been widely used as a biostimulant to increase plant growth [4]. The use of seaweed as fertilizers has been reported more effective in plant productivity compared to chemical fertilizers. Seaweed extract contains many micronutrients, organic materials such as carbohydrates, amino acids, plant growth factors or Plant Growth Regulator [5]. The

primary key in producing organic seaweed fertilizer is the breakdown of seaweed cell walls to obtain active components and sustainably maintain their activities. The use of fermented seaweed extract was reported to positively affect plant growth and minimalize adverse effects on the soil [6]. Therefore, the research was conducted to obtain seaweed extract fermented by combining microbes to increase the corn plant growth.

## 2. Materials and Methods

### *2.1 Algae extract preparations*

The Brown Algae was fermented at Biology Laboratory, Universitas Negeri Makassar while, the field experiments were conducted at Sokkolia field experiments, Gowa District from October to December 2020. Fifty-seven grams of dried brown Algae (*Sargassum* sp.) were added by 171 ml buffer pH 6 and then sterilized before inoculating with 57 ml of a suspension of fungi (*Trichoderma harzianum* and *Gliocladium* sp.), and bacteria suspensions (*Bacillus subtilis* and *Paenybacillus polymyxa*) with a density of 107 cell/ml, then it incubated at room temperature for 18 days in a closed container. Fermentation was stopped by adding 1.5 liters of distilled water and pasteurized using a water bath at a temperature of 60°C for 30 minutes and 90°C for 1 minute. Finally, the suspensions were filtered using a filter cloth.

### 2.2 *Field experiments design*

The treatments were arranged in a randomized block design with four replications consisting of 5 treatments namely control, UPK fertilizer (Urea, Phosphate, and Potassium at rate 150 kg-N/ha 80 kg-P/ha and 80 kg-potassium/ha), brown algae extract (*Sargassum* sp.), brown algae extract fermented with *T. harzianum* and *Gliocladium* sp., and bacterial fermented (*B. subtilis* and *P. polymyxa*). Pulut variety corn seeds were planted in each plot size 2x1 cm were consisting of 5 plots with 4 replications. Each plot was planted with 20 sweet corn seeds (Bonanza F1). Brown algae fermented liquid at the concentration of 5 % were sprayed at 7, 17, 27, 37, 47, and 57 days after planting (DAP). At the same time, UPK treatments were applied two times only at 7 and 32 DAP. The parameters observed were the vegetative phase (corn plant height and corn stalk circumference) and the generative phase (corn cob length, corn cob diameter, number of rows of seeds in corn, and number of seeds in corn rows). Data were analyzed using the technique of analysis of variance (F test) or ANOVA. In addition, Duncan's test was applied to see the comparison between treatments.

## 3. Results and Discussion

### *3.1. The growth of vegetative corn*

The vegetative phase is the phase from the first leaf to appear before the silk emerge. The vegetative stage includes corn plant height (cm) and corn stalk circumference (cm). The average height of corn plants can be seen in Figure 1. This study indicated that extracts of brown algae (*Sargassum* sp.) fermented influence the growth of corn plants.

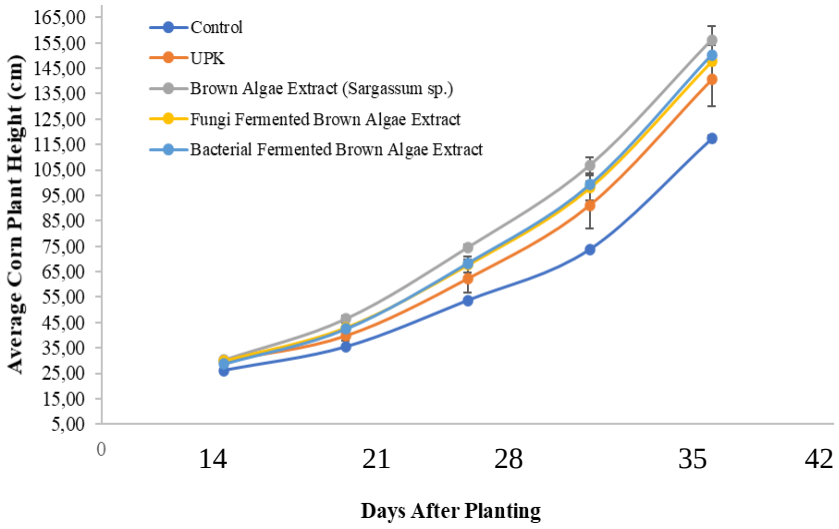


**Figure 1.** The average Plant Height of Corn

The treatment of brown algae extract, UPK, fungal fermented brown algae extract, and bacterial fermented brown algae extract at 14, 35, and 42 DAP were significantly different from the control. At 21 DAP the treatment of fungal fermented brown algae extracts and bacterial fermented brown algae were significantly different from the control. At 28 DAP the treatment of brown algae extract, fungal fermented brown algae extract, and bacterial fermented brown algae extract were significantly different from the control.

The application of seaweed shows growth-stimulating activity. Seaweed components such as macro and micronutrients, amino acids, vitamins, cytokinins, auxin, and abscisic acid (ABA) growth substances affect the plant cell metabolism and increase the growth and yields of Plant [7]. Brown algae also contain nutrients and organic iron as growth stimulation, iodine, vitamin C, and minerals such as Ca, K, Mg, Na, Fe, Cu, Zn, S, P, Mn, and others [8]. In addition, the increase of growth of plants is also stimulate by phytohormones, abscisic acid, gibberellins, brrassinosteroids and castasterone which help support plant growth under nutrient stress [9]. Based on the results obtained, the average corn stalk circumference (cm) can be seen in Figure 2.

The results of this study showed that the treatment of brown algae extract (*Sargassum* sp.) differed markedly from the controls, but the different control treatment was not real with UPK and mushroom fermented brown algae extract, and for the treatment of UPK different is not real with the extract of brown algae fermented fungi and extracts of brown algae fermented bacteria. This is by following under with the theory that spraying algae extract containing micronutrients (Co, B, Mo, Zn, Cu) and macronutrients (N, P, K) as a growing driving hormone can increase thickness and strengthen the stem. The administration of algae extracts will increase growth, increase cell numbers, increase the absorption of nutrients including nitrogen which is a component of cells and increase the formation of macromolecules. Therefore, that might enhance stems to become stronger and reduce their vulnerability to collapse [10]. In addition, extracts of algae that contain elements of micronutrients and macro and growth-promoting hormones can increase nutrient absorption and increase stem thickness [11].

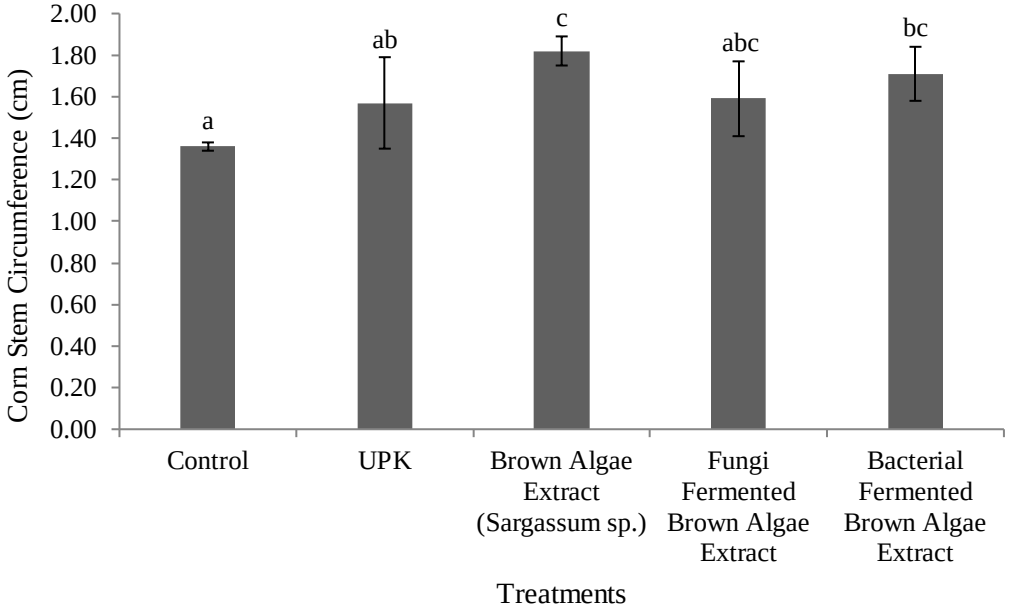


**Figure 2.** The average Corn Stem Circumference (cm)

*3.2 The growth generative phases of Corn*

The generative phase or reproductive phase is the growth phase after sikling until they achieve maturity. The generative phase included the cob's length, the diameter of the cob, and the number of rows of corn seeds. Based on the results obtained, the average length of corn cobs (cm), a diameter of corn cobs (cm), number of seeds in corn rows, the number of rows of corn seeds, and the number of seeds in corn row after harvesting can be seen in Table 1.

**Table 1.** The Generative phase after corn harvest

| Treatments | Average Length of Corn Cobs (cm) | Average Diameter of Corn Cobs (cm) | Average Number of Rows of Seeds in Corn | Average Number of Seeds in Corn Row |
|---|---|---|---|---|
| Control | 14,32[a] | 2,21[a] | 10,16[a] | 19,41[a] |
| UPK | 17,47[b] | 2,66[b] | 11,66[bc] | 26,33[b] |
| Brown Algae Extract | 17,90[b] | 2,72[b] | 12,66[c] | 27,49[b] |
| Fungi Fermented Brown Algae Extract | 16,81[b] | 2,60[b] | 12,00[bc] | 27,25[b] |
| Bacterial Fermented Brown Algae Extract | 17,73[b] | 2,73[b] | 11,33[b] | 25,41[b] |

Note: The same numbers letter in the column shows no significant difference based on the results of Duncan's test (0.05).

The results of this study showed that brown algae extract (*Sargassum* sp.) can influence the generative phase. Parameters of cob length, the diameter of cob and number of seeds on cornrows, Treatment of brown algae extract (*Sargassum* sp.) has longer corn cob length and control treatment has shorter corn cob length more among other treatments. UPK treatment, brown algae extract (*Sargassum* sp.), fermented brown algae extract fungi and bacterial fermented brown algae extract are different from

control treatment, but UPK treatment, brown algae extract (*Sargassum* sp.), fungal fermented brown algae extract, and different bacterial fermented brown algae extract are not noticeable. Parameters of the number of rows of seeds in corn, The treatment of brown algae extract (*Sargassum* sp.) has more rows of seeds on corn and the control treatment has a smaller number of rows of seeds on corn among other treatments.

The UPK treatment, brown algae extract (*Sargassum* sp.), fungi fermented brown algae extract were significantly different from the control. Following some reports, the nutrient and growth hormone content in brown algae is suitably enhancing the growth of the generative phase and producing a good plant-quality product. In addition, the addition of organic matter affects the yield of corn cobs [12]. Nutrients that play a role in plant generative growth are nitrogen and phosphate, which play a role in flower formation and affect the appearance and size of cobs. The availability of nutrient elements was largely transferred during the generative phase can stimulate the formation of corn cob [13]. The growth hormone owned by algae, such as cytokines, play a role in cell division that causes the growth response of fruit increased [14], also the content of plant growth regulator (PGR) of algae might increase the fruit production [15].

The use of organic fertilizers can enhance plant growth in vegetative and generative phases. The application of algae increases plant production due to the presence of organic and inorganic materials that can help nutrient absorption or nutrient uptake and stimulate photosynthesis [16]. The compound that extracts algae is a polysaccharide compound, phenolics, phlorotannin, proteins, peptides, essential amino acids, lipids, terpenoids, steroids, vitamins, and minerals [17]. Therefore, algae extract contains many essential minerals from the sea that plants need, and algae also contain growth-promoting hormones that have been shown to increase plant growth and crop yields [18].

Extract of fermented brown algae can affect the growth of corn. The macronutrient and micronutrient content of algae extract can help support plant growth and production. It can be seen in the application of fertilizers organic extracts of algae fermented fungi and extract Fermented algae brown bacteria were better than the control treatment. The UPK (synthetic fertilizers) treatments seem to have the same effect on brown algae extract treatment at the vegetative and generative phases.

## 4. Conclusion

The growth of vegetative and generative phases of corn were affected plant height, stem circumference, cob length, cob diameter and number of rows of seeds by application of by application of brown algae extract fermented.

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