Effect of sucrosin bio stimulant on early growth of sugarcane
(Saccharum officinarum L.) var. CM 2012

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Abstract. A study was carried out to study the effect of sucrosin bio stimulant application on the early growth of sugarcane (Saccharum officinarum L.) var. CM 2012 at the PT Perkebunan Nusantara XIV Arasoe Sugar Factory, Bone Regency, South Sulawesi from June to September 2019. The sucrosin was applied by immersing three segments of sugarcane cuttings (three eyes) for 30 minutes, then planted in a separate block from control treatment, with an area of 3 ha, respectively. Plant sampling was carried out diagonally on 10 rows of plants with a line length of 10 m per row. Data analysis was carried out using t test at α=0.05 level, correlation, and regression analysis to compare the growth parameters of sugarcane shoots, and to determine the relationship between shoot growth and the sucrosin treatments. The results show that the application of sucrosin to sugarcane cuttings significantly increased the early growth of sugarcane indicated by increase in shoot height, shoot and tillers number, and the number of leaf chlorophyll. The variable value of sucrosin treatment was highly correlated with the control indicated by the highest correlation value in the leaf chlorophyll number (0.996) and the lowest in the shoot height increase (0.991). The increase of the sucrosin treatment value in the regression equation is greater than the control, means, for each addition of one control value, the value of sucrosin treatment increase by 4.39, 10.70, 8.11 and 1.99 in the parameters of shoot height, number of primary shoots, number of tillers, and leaf chlorophyll number of sugarcane, respectively.

1. Introduction
Sugarcane (Saccharum officinarum L.) is an important plantation commodity as the main raw material for the sugar industry. Until now, domestic sugar production which is only around 2 million tons per year is not sufficient for the national sugar demand which has reached 7 million tons in 2018 [1]. The low sugar production is due to limited area and low sugarcane productivity, where the production area is only 430 thousand hectares with a productivity of around 5 million tons of sugar per hectare [2]. In addition, sugarcane production is also determined by the quality of the seedlings used [3, 4].

Sugarcane shoots that can grow from sugarcane seedlings only around 30-35%, hence causing low sugarcane yields and contribute nearly 25% of operational costs [5, 6]. Therefore, efforts are needed to develop techniques that will increase the germination percentage and yield of sugarcane. One of the
important factors that play a role in the germination of sugarcane cuttings and the initial growth of the seedlings is the food reserves and growth hormones contained therein [3]. Growth hormone or also known as plant growth regulators is known to improve source and sink relationships, stimulate assimilate translocation so as to help develop seeds or seedlings and ultimately increase plant productivity [7].

Synthetic growth hormones such as atonik and Rotoone F have been used to treat sugarcane eye buds before planting. The treatment of atonic growth hormone by immersing bud chip seeds for 30 minutes had a significant effect on the number of leaves two weeks after planting on soil media with compost [8]. While the application of Rootone F has a significant effect on the percentage of shoot growth, stem diameter, root volume, wet weight and root dry weight in the early growth of sugarcane [9]. Soaking seeds with Paclorbutrazol (PP333) at a concentration of 50 mg / L is effective in increasing the formation of sugarcane tillers, chlorophyll content, dissolved protein levels, proline levels and sugarcane leaf peroxidase activity [10]. The use of natural growth hormone of young coconut water on bud chip sugarcane seedlings had a significant effect on root volume, leaf area, fresh weight and dry weight of roots and tops of sugarcans at the age of 40-120 days after planting [11].

Growth hormone is also present in various bio stimulant products. Commercial bio stimulants contain growth hormones consisting of auxins, cytokinin, and gibberellins [12]. Bio stimulants are complex substances containing plant growth-promoting substances, their application to plants or plant materials can improve hormonal balance, support genetic potential, increase nutrient efficiency, tolerate abiotic stress and increase shoot and root growth [12, 13]. Bio stimulants are formulations of biological materials such as bacteria, fungi, seaweed, higher plants, animals and other materials containing humic, which produce growth regulators and plant protection compounds so that their application can increase plant productivity [14]. Local seaweed-based bio stimulants have been tested for their effect on the better vegetative growth of sugarcane PSJT-941 compared to those without bio stimulants [15].

One of the bio stimulants that can be used in planting material is Sucrosin. Sucrosin is a bio stimulant plus resulted from research of the Bogor Center for Biotechnology and Bioindustry Research which contain growth regulators, namely auxins, cytokinins and gibberellins, macro and micro nutrients, activators, organic acids, vitamins and antioxidants. The application of sucrosin to sugarcane can stimulate plant metabolic processes thereby increasing the biomass and sugar content of cane [16, 17]. The use of Sucrosin has been implemented by PT Perkebunan Nusantara (PTPN) VII in Lampung and South Sumatra to increase sugarcane productivity and sugar production [18]. Therefore, a study was conducted to examine the effect of sucrosin application on the early growth of CM 2012 sugarcane in Bone Regency, South Sulawesi.

2. Methodology

2.1. Experimental design

The research was conducted from June to September 2019 in the sugarcane field of PTPN XIV Arasoe Sugar Factory in Tellongeng Village, District, Mare, Bone Regency, South Sulawesi. The study was designed to compare the effectiveness of sucrosin on the growth of sugarcane shoots and tillers. The observation sample consisted of plants in 10 planting blocks (sections) planted in separate blocks where the area of each planting block was 3 ha, respectively. Plant sampling was carried out diagonally on each row with the observed line length of 10 m per row.

2.2. Seeds preparation

The sugarcane seeds used were six months old CM 2012 variety. Seedlings were taken by cutting the base of the sugarcane, then removing the tip / shoot and the rooted stem. Next, the seedlings were cut in the form of three buds before treated with sucrosin.
2.3. Sucrosin application
For the treatment application, a sucrosin solution was made with a concentration of 1 ml L$^{-1}$ of water as much as 750 L. Furthermore, the three bud chips prepared previously from sugarcane seedlings (30 bud chips per lot) were immersed in a sucrosin solution for 30 minutes.

2.4. Observation
Observation of the early growth of sugarcane was carried out at the age of 2 weeks after planting (WAP). Parameter observed were number of shoots that grew, height of the shoots, measured from the soil surface to the tips of the leaves on four clumps of plants in the middle, and number of secondary shoots (tillers) that grew in each observation period. Furthermore, at the age of 4 WAP, the leaf chlorophyll measurements were carried out on the 3rd or 4th leaf blade from the top leaf using an MC-100 chlorophyll meter.

2.5. Data analysis
Comparison between the data on the growth of sugarcane shoots from sucrosin treatment and control data was conducted using the t test [19] at the $\alpha_{0.05}$ level. The hypothesis used is:

$H_0 \ D = 0$, means the difference in the mean value of shoot growth yield in sucrosin treatment against the mean value of control treatment, is equal to zero.

$H_1 \ D \neq 0$, means difference in the mean value of shoot growth yield in sucrosin treatment to the mean value of control treatment, is equal to zero.

The relationship between the shoot growth yield of sucrosin treatment and control treatment using regression analysis, the mathematical equation is as follows:

$$Y = \beta_0 + \beta_1X + \epsilon_1$$

where:

- $Y$ = the value of shoot growth in control treatment
- $\beta_0$ = constant
- $\beta_1$ = regression coefficient
- $X$ = the value of shoot growth in sucrosin treatment
- $\epsilon_1$ = error

3. Results
3.1. Shoot height.
The increase in shoot height in the initial phase at the fourth week did not show a significant difference between sucrosin treatment and control, until the eighth week a significant difference was shown by sucrosin treatment.

### Table 1. The average shoot height increase in control and sucrosin treatment.

| Treatment | Shoot height increase (cm) | Weeks after planting (WAP) |
|-----------|---------------------------|----------------------------|
|           |                           | 4  | 6  | 8  |
| Control   |                           | 57.20 | 54.00 | 17.50 |
| Sucrosin  |                           | 55.90$^{ns}$ | 54.25$^{ns}$ | 39.25$^*$ |
| $t_{a 0.05}$ |                         | 0.831 | 0.976 | 0.045 |

$ns =$ not significant, $^*$ = significant at $\alpha_{0.05}$.
3.2. Number of primary shoots, tillers and total shoots.
Sucrosin application treatment significantly increased the number of primary shoots and tillers per meter of the sugarcane seedlings compared to the control.

### Table 2. Average number of primary shoots, tillers and total shoots of sugarcane per meter at 9 weeks after planting in control and sucrosin treatment.

| Treatment   | Number of primary shoots | Tillers   | Total shoots |
|-------------|--------------------------|-----------|--------------|
| Control     | 28.30                    | 72.10     | 120.70       |
| Sucrosin    | 42.30*                   | 123.10*   | 162.40*      |

*[^0.05] = significant at 0.05.

3.3. Leaf chlorophyll number
The amount of leaf chlorophyll also increased significantly at 4th week with sucrosin treatment compared to control, but at 6th and 8th week, it did not appear to be significantly different.

### Table 3. Average number of chlorophyll of sugarcane leaves in control and sucrosin treatment.

| Treatment | Number of chlorophyll (unit) |
|-----------|------------------------------|
|           | Weeks after planting (WAP)   |
|           | 4   | 6   | 8   |
| Control   | 26.73 | 41.19 | 54.83 |
| Sucrosin  | 32.72* | 42.73ns | 55.71ns |

ns = not significant, * = significant at 0.05.

3.4. Linear regression analysis
The relationship between sucrosin treatment and control which is described by the positive linear regression equation shows that the relationship between the two is very close with a high correlation value (0.991 - 0.996). The highest correlation value appears in the variable amount of leaf chlorophyll and the lowest is the height of sugarcane shoots. The regression equation shows the added value of sucrosin treatment is greater than the control value, that is, the value of sucrosin treatment increases by 4.39, 10.70, 8.11 and 1.99 for each increase of one control value on the parameters of shoot height, number of primary shoots, number of tillers, and number of chlorophyll of sugarcane leaves.
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**Figure 1.** Relationship between sucrosin and control: (a) shoot height (cm), (b) primary shoots per meter, (c) number of tillers per meter, and (d) amount of chlorophyll (unit).

4. **Discussion**

To increase the germination rate of sugarcane shoots, it is necessary to activate the germination of the lateral shoots which is directly related to the hormonal balance in the shoots. This is determined by the comparison of the levels of growth inhibiting substances such as auxin and ABA with levels of growth hormones such as gibberellin, cytokinins, and ethylene in the shoots and then determines the initial growth of sugarcane [20]. El-Enien and Omar [21] stated that the application of exogenous growth regulators may work effectively on roots by increasing the total IAA and decreasing the ABA levels of cuttings.

Treatment on sugarcane buds such as soaking the cuttings in bio stimulants is very important to improve the seed quality, especially in increasing shoot germination. The active period of shoots and the germination stage lasts for 45 days, followed by the formation of tillers for about 120 days. The stage of tillers formation is a determining factor for sugarcane yield [22]. The use of sucrosin bio stimulant on sugarcane cuttings had a significant effect on primary shoot growth and stimulated the formation of the number of tillers and the amount of leaf chlorophyll. This is because the growth hormone content in sucrosin plays a role in accelerating the emergence of shoots and increasing the initial growth of sugarcane as a result of vital processes and internal structures that affect plant growth through increasing tolerance to abiotic stress and improving the quality of seeds [23].
The rate of increase in early growth of cuttings with sucrosin bio stimulant immersion treatment was higher than that of control plants (Figure 1) both in parameters of shoot height, number of primary shoots and tillers and the amount of chlorophyll. This is due to the content of growth hormones in bio stimulants which work effectively to increase the growth rate of cuttings which is triggered by increased cell division, differentiation and extension [12].

5. Conclusion
The application of sucrosin to sugarcane cuttings significantly increased early growth of sugarcane as indicated by the parameters of the increase in shoot height at eighth week, the number of shoots and tillers per meter and the number of leaf chlorophyll at the fourth week. The value of the sucrosine treatment variable was highly correlated with the control indicated by the highest correlation value on the amount of leaf chlorophyll (0.996) and the lowest on the increase in shoot height (0.991). The increase in the value of sucrosin treatment in the regression equation was greater than that of the control, meaning that for each addition of one control value, the value of sucrosin treatment increased by 4.39, 10.70, 8.11 and 1.99 on the parameters of shoot height, number of primary shoots, number of tillers, and the number of chlorophyll of sugarcane leaves.

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