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Application of Sodium Alginate on Encapsulation Sugarcane Bud Chips (*Saccarum offisinarum* L) To Improve Seed Quality and Production

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Abstract—

Sugar self-sufficiency is a big challenge, one of the reasons for the low sugarcane production is the supply and quality of seeds. Sugarcane seeds are the main problem experienced by farmers when unloading ratoons is the procurement of seeds. The use of bud chips which are encapsulated using Sodium Alginate (C6H7O6Na)n, is the first step to answer the difficulties of farmers in supplying sugarcane seeds and sending seeds long distances.

The purpose of this study was to analyze and evaluate the optimization of bud chip sugarcane seedlings using bud chip coating technology using Sodium Alginate. The research was carried out at the East Java Sweetener and Fiber Crops Research Institute (Ballitas) in Karang Ploso, Malang Regency, on June 17, 2019 s. d 17 September 2019 . The study was structured using a non-factorial completely randomized design, with 4 (Treatment), namely S0 (Control = No encapsulated), S1 (Encapsulation using Sodium Alginate Concentration 10 g/L), S2 (Encapsulation using Sodium Alginate 20 g/L), S3 (Encapsulation using Sodium Alginate 30 g/L) .

The results showed that the use of Sodium Alginate with a concentration of 20 g/L was proven to show the best average shoot growth, reaching 92.59% at the age of 42 DAP. With respect to the number of leaves, the highest value was produced at 56 DAP by treatment of 20 g/L Sodium Alginate of 5.19 strands which was significantly different from all treatments. The highest plant height was achieved by treatment of 20 g/L Sodium Alginate of 47.53 cm, which was not significantly different from the control and 10 g/L Sodium Alginate and S0 (control) was not significantly different from the 30 g/L Sodium Alginate (S3) treatment, while the parameters of chlorophyll, leaf area, root length and dry stover weight were controlled (S0).) is equal to 10 g/L Sodium Alginate (S1), 20 g/L Sodium Alginate (S2) is different from Control (S0) and 10 g/L Sodium Alginate (S1) and 20 g/L Sodium Alginate (S2) is not the same with 30 g/L Sodium Alginate (S3).

***Keywords*— Sugar, Treatment, Technology,**

INTRODUCTION

As the main material for producing sugar, sugar cane has an important role in the sustainability of the sugar industry in Indonesia. Along with the development of population, Indonesia has not been able to fulfil the deman of the national sugar consumption (Gusti, 2018). This is evidenced by the decline in sugarcane productivity in 2017 which only reached 5.4 tons / ha compared to 2016's projection of 7.75 tons / ha (Plantation Statistics, 2017). Sugar self-sufficiency is a big challenge because there are still problems with sugar cane in the upstream and downstream industries.

The problem were due to land availability, seed availability, seed quality, understanding of the role of varieties, ratoon system is not being implemented massively, plant health and crop nutrient needs by farmers is on unsufficient level, in which all have an impact to the low productivity and

quality of sugarcane yield as raw material for sugar (Sugiyarta, 2012; Purlani et al., 2015). Low sugarcane production can be seen from the onfarm site, in which including seed quality, seed availability and nutrient availability for plants or on factory site which less effectively on prossesing sted to produce sugar due to lack in revitalizing old equipment and their prossesing management. The availability of sugar cane seeds is a problem faced by farmers when ratton system was being replaced with bud chop seed system (Purlani et al., 2015).

The use of planting material derived from bud chips is the application of technology in the framework of national sugar self-sufficiency, this is the first step in facing the difficulties of farmers to meet the number of new seedlings when carrying out ratoon loading. Agricultural Research and Development Agency (2015) and Irianti et al., (2017) noted that the use of sugar cane seeds using bud chips more efficient and suppresses 75-80% land area usage, furthermore Sugiyarta (2012) in Khuluq et al., (2016)) reports, that the most critical period in the growth and development of sugarcane is in the germination and shoot growth vases. Reddy et al., (2012) reported that encapsulation trials were carried out on several types of plants developed from somatic embryo cells, including sugarcane. Iffah et.al (2015) reported that administration of 4% Sodium Alginate concentration showed the best percentage of germination and number of shoots in the development of sugarcane originating from the development of somatic embryo cells. Prasad (2007) reports that the use of bud chips has several advantages compared to the use of conventional seeds where bud chips make transportation easier, free from pests and can be obtained from pure seeds, but bud chips that are produced and stored in an improper way will reduce power sprouts from the bud chip. Furthermore Jannifer et al., (2018), reported the results of research on encapsulation of bud chips using Sodium Alginate to increase the potential for bud growth potential in early growth, apparently encapsulation with Sodium Alginate at doses of 10, 20, 30, 40 and 50 gr / l combined with 300 mM Calcium Clorida inhibits the initial growth of plants although it is physiologically beneficial for maintaining the quality of bud chips. Saisprasad (2003), reports that Sodium Alginate is the most accepted hridrogel for synthetic seed matrices, because it is cheap, quickly forms gelatin, and has low toxicity. Nieves et al., (2003) reported that CP 5243 cultivated sugar cane developed from artificial seeds showed lower plant diameters and higher plant heights up to 8 months compared to conventionally developed plants, and the difference disappeared when plants 12 months old, and sugar levels and results showed no difference. Considering the quality and quantity of sugarcane seed stocks is a problem in Indonesia, it is necessary to make an alternative effort to develop and research sugar cane bud chips to improve the quality and quantity. Research on the development of sugarcane seedlings by the encapsulated bud chip method has not been done much, so it needs to be developed. The purpose of this research was to examine the impact of Sodium Alginat on the performance dan productivity of sugarcane budchip.

I. MATERIAL AND METHOD

This research was conducted at the Research Institute for Sweeteners and Fibers (Ballitas) Karang Ploso, Malang Regency, East Java, Indonesia, on June 17, 2019 after 17 September 2019. The materials used in this study included sugarcane seeds, Bud chip Varieties of CMG Mlg Agribun, Kascing, Sodium Alginate, CaCl3, Fungicides, Insecticides, Atonic, Water and Entisol soil. The tools used include Pottray 63 holes, Bud chip Cutting Tool, HWT (Hot Water Treatment), meter, scale, rod diameter gauge, gembor, soil filter, plastic tub, SPAD, LAM, Oven.

This study used a completely randomized design (CRD), non-factorial with 4 levels and was repeated six times. The tested factor is the concentration of Shodium Alginate which consists of 4

(four) levels, namely S0: (0 ml gram Shodium Alginate / L water), S1: (10 ml gram Shodium Alginate / L water), S2: (20 ml gram Shodium Alginate/L water), S3 : (30 ml gram Shodium Alginate/L water)

In this study, entisol was used as a planting medium, which was sterilized and then mixed with vermicompost vermicompost in a ratio of 1:1. The bud chips used came from the CMG Malang Agribun variety of sugarcane. Prior to encapsulation, the Bud chips used in this study were sterilized using Hot Water Treatment at a temperature of 30 0 C for 30 (thirty) minutes, and immersed in a solution of Fungicide 1 ml/10 L water, Insecticide 1 ml/1 L water, ZPT 1 ml/L water for 45 minutes. Then the bud chips were immersed in Sodium Alginate at a concentration of S0= without Sodium Alginate, S1= 10 g/L Sodium Alginate, S2= 20 g/L Sodium Alginate, S3= 30 g/L Sodium Alginate, for 30 minutes. The bud chip was transferred to a 0.1 mol CaCl3 solution for 5 minutes then air-dried. Then the bud chips were planted in a pottray with a size of 52 cm x 26 cm consisting of 63 holes, placed under a shade, covered with dark plastic for two days, and observed for growth up to 70 DAP. Treatment includes watering every three days. Observational data obtained were analyzed using analysis of variance (F-test) at 5% level, if it had a significant effect, proceed to the T-test level using BNT at 5% level to see differences in results between treatments.

II. RESULT AND DISCUSSION

1. Non Destructive Observation

1.1. Percentage of Growing Shoots

The results of the Anova Variety Print showed a significant difference in the percentage of shoot growth (Table 1), at the age of the plant from 14 DAP to 28 DAP the treatment of 20 g/L Sodium Alginate (S2) showed the best results but was not significantly different from the Control (S0) and 10 g application. /L Sodium Alginate, but at the end of the observation at 42 DAP the application of 20 g/L Sodium Alginate (S2) showed the best results of 92.59%, which was significantly different from the control (S0), while the control was not significantly different from the application of 10 g /L Sodium Alginate (S1), but S0 and S1 were significantly different with the application of 30 g/L Sodium Alginate (S3), which showed the lowest growth rate of 43.54%.

TABLE 1

Average Percentage (%) of Shoots Growing at the age of 7 DAP to 42 DAP

Treatment	14 HST	28 HST	42 HST
without Sodium Alginat (S0)	42,44 b	53,38 b	75,51 b
10 g/L Sodium Alginat (S1)	35,83 b	49,64 b	69,44 b
20 g/L Sodium Alginat (S2)	44,09 b	65,55 b	92,59 c
30 g/L Sodium Alginat (S3)	6,06 a	19,84 a	43,54 a
BNT 5%	32,10	16,46	13,67
KK	41,39%	29,01%	16,15%

Source: Primary Data Analysis Results 2019

The percentage of germination with the highest yield was shown by the treatment of 20 g/L Sodium Alginate (S2) which was different from the control (S0), while the lowest percentage of seedling

growth was obtained in the treatment of 30 g/L Sodium Alginate (S3) Iffah et al.(2015) have conducted an encapsulation test on sugarcane seeds derived from somatic embryo cells, where at a concentration of 4% showed the best percentage of sugarcane seeds. Jeniffer et al., (2018) reported that dressing on sugarcane chip buds actually inhibited the initial growth of shoot growth. Anshar (2012) reported that concentrations that are too low have not been able to cover all pores in guava fruit, while concentrations that are too high actually damage cell walls.

Concentration of 20 g/L Sodium Alginate showed the optimal concentration for encapsulation in sugarcane, because at a concentration of 30 g/L actually caused the percentage of bud chip growth to decrease. The inhibition of respiration will slow down the metabolic rate, namely the dismantling of food reserves contained in plant cells (Okonkwo NJ, 2015). The application of Sodium Alginate protects the bud chip from damage by covering the pores on the bud chip, so that the respiration process becomes hampered, where the nursery is the initial stage to obtain plants to be cultivated, so good seeds are a determining factor to obtain good plants as well (Manahan et al., 2016) Manganese fruit coated with Sodium Alginate at a concentration of 25 ppm was able to extend the shelf life of the fruit from 5 days to 17 days (Anshar 2012). In this study, after soaking the bud chips with Sodium Alginate, they were soaked in CaCl with a concentration of 300 mlM for 5 (five) minutes (Jannifer et al., 2018); Breemer et al., (2015) stated that the results of their research using CaCl at a concentration of 12% was the best because it was able to reduce fruit shrinkage by 1.04%. The germination phase is an important phase in sugarcane cultivation (Djumali, 2016). Good seeds are planting material that determines sugarcane production. According to Sohail et al., (2018), Alginate: 41.24 me/100g is a versatile sanitary napkin that is commonly used in the food and non-food sectors.

latosol with andesite breccia structure, basalt andesite lava, clay tuff, silt, sand, gravel). and lava rocks) with a tropical climate with an average rainfall of 24.55 mm/year and an average temperature of 25.8^{o} C, with a topography of 0 to 1,730 masl, not much different from the conditions in other islands. Following are the results of the analysis of the intensification and extensification strategies in Table 2.

1.2. Number of Leaves

Based on the results of ANOVA variance and 5% BNT further test on the number of leaves (Table 2) showed significant differences in treatment at the age of 28, 42 and 56 DAP. At the age of 28 and 43 DAP treatment, the highest number of leaves was shown by the 20 g/L Sodium Alginate treatment, but it was not significantly different from the 10 g/L Sodium Alginate (S1) treatment, while the highest value for the number of leaves was reached at 56 DAP with 5.19 leaves/ plants were shown by the treatment of 20 g/L Sodium Alginate which was significantly different from all treatments. (Ricardo et al., 2015); (Salisbury., et al, 1991); (Pertamawati, 2010). The leaves on sugar cane grow on the leaf segments, the higher the plant, the number of segments where the leaves grow on sugar cane will also increase.

Leaves are the main organs for photosynthesis, the photosynthetic results will be remodeled back into energy in respiration events, the energy produced is used in cell division and growth so that the leaves can reach optimal width. Afifuddin (2017), explained that the combination of Hot Water Treatment for 30 minutes and Gibberellins 1.5 ml/L, at the age of 58 DAP on sugarcane rootstock bud chips was able to produce 9 leaves/plant, then the more and the leaf area width, the higher the leaf area. the photosynthetic function will increase, so it is expected that the results of photosynthesis will increase, the results of research from Afcarina (2020) show that the combination of various seed

sources (Bud Chip and Bud sed) in several varieties grown in polybags did not show significant differences in leaf area with the average yield was 6 strands per plant at 58 D

TABLE 2

Average Number of Leaves at Age 28 to 56 DAP (strands/plants)

Treatment	28 HST	42 HST	56 HST
Without Sodium Alginat	2,87 a	3,65 a	4,45 a
(S0)	3,35 b	3,98 ab	4,53 a
10 g/L Sodium Alginat (S1)	3,43 b	4,14 b	5,19 b
20 g/L Sodium Alginat (S2)	2,58 a	3,60 a	4,23 a
30 g/L Sodium Alginat (S3)			
BNT 5%	0,43	0,50	0,46
KK	12,73 %	9,63 %	4,41 %

Source: Primary data analysis 2019

1.3. Plant height

The results of the Anova variance test (Table 3) on plant height parameters showed the highest value at 56 DAP with a value of 47.53 cm by 20 g/L Sodium Alginate treatment but not significantly different from control (S0) and S1 (treatment 10 g /L Sodium Alginate) .

TABLE 3

Average plant height at the age of 28 DAP to 56 DAP (cm/plant)

Treatment	28 HST	42 HST	56 HST
Tanpa Sodium Alginat (S0)	31,00	37,83 a	43,67 ab
10 g/L Sodium Alginat (S1)	29,67	41,03 b	46,67 b
20 g/L Sodium Alginat (S2)	31,75	37,17 a	47,53 b
30 g/L Sodium Alginat (S3)	26,50	37,67 a	41,83 a
BNT 5%	Tn	3,16	4,35
KK	13,13%	8,60%	4,24%

Source: Primary data analysis 2019

Plant height is an indicator of growth. The increase in plant height is an increase in the size of the cells due to increased yield (Harjanti, 2014). Growth is an irreversible increase in the number and size of cells. Environmental factors that affect plant vegetative growth include nutrition, light and humidity (Mc Cauley et al., 2011). Based on the laboratory test results, the total N content of vermicompost was as follows: N:1.80 (low), P: 0.96 (very low) and K 0.16, also in very low status, combined with entisol soil in a ratio of 1: 1 (one to one). Planting media is related to soil nutrition, in this trial using a mixture of vermicompost with entisol which has a relatively low nutrient content in a ratio (1:1), the

media used in limited quantities, namely only in pottrays with a size of 6x6 cm, so that It is suspected that the soil nutrients needed by plants are also in minimum conditions to meet plant growth.

Plant height is a manifestation of the development and elongation of cells in the stem, the stem has a function as a plant support, connecting roots with leaves, helping to transport water and minerals that are absorbed to various parts of the plant as well as helping transport photosynthetic products from leaves to other parts of the plant body. (Brainkart, 2017 ; Byjuy's, 2020). Parameters of plant height at the beginning of the observation at the age of 28 DAP showed a value that was not significantly different in the overall treatment until the end of the observation of plant height at the age of 56 DAP, where S1 was only different from S3 but not significantly different from the control (S0) and 10 g/ L Sodium Alginate (S2), although in real terms the highest value was achieved by the treatment of 2 g/L Sodium Alginate (S2) with a value of 47.53 cm, while Afiffudin (2017), presented the results of his research by combining the heating time and the addition of Gibberellins to the buds. the chip was able to show a plant height of 45.15cm at the same age, it appears that the application of Sodium Alginate to a certain extent will suppress plant height, which is indicated by the lowest plant height value of 41.83 cm not significantly different from the control (S0), i.e. 43.67 cm. Plant height is also influenced by available nutrients in the planting media, in this study the plants grew in pots with a size of 6x6, using Inceptisol soil media with relatively low nutrient content combined with vermicompost with a ratio of 1:1, Kasno (2009) explained the results of his research that P fertilization was found to increase the levels of potential available P, where the element P is a limiting factor for plant growth.

2. Destructive Observation

2.1. Leaf Area

Leaves are part of the plant body that has a function as a place for photosynthesis. The results of the analysis of variance on the leaf area parameters showed a significant effect of treatment only at the age of 49 DAP and 56 DAP, the Sodium Alginate treatment, the results of the 5% BNT further test at the age of 49 DAP, the highest leaf area was shown by the 10 g/Liter Sodium Alginate (S1) treatment. which is not significantly different from S0 and S2, but in S0 treatment is not significantly different from S2 and S3 treatment. The lowest value was indicated by the S3 treatment (10 g/L Sosium Alginate). Age 56 DAT S3 treatment also showed the lowest results which were not significantly different from S2 but significantly different from the control and S1. The results of this study also prove that the application of Sodium Alginate up to a certain point also reduces the area of the leaves of the sugarcane plant.

The development of sugarcane seeds using bud chips is one of the breakthroughs to address the problem of the low supply of seeds at the time of unloading the ratoon. Sugarcane is one of the commodities that have important economic value so that farmers are expected to be able to utilize the land and increase their income (Pastika, 2018), this is in accordance with what is explained by Reddy (2012), that synthetic seeds are developed on commodities that have important economic value

TABLE 4

Average Leaf Area at the age of 28 DAP to 56 DAP (cm2/plant)

Treatment	42 HST	56 HST	70 HST
Tanpa Sodium Alginat (S0)	14,84	29,81 b	43,67 ab
10 g/L Sodium Alginat (S1)	16,48	30,45 b	46,67 b
20 g/L Sodium Alginat (S2)	14,08	26,37 ab	47,53 b
30 g/L Sodium Alginat (S3)	11,37	18,54 a	41,83 a
BNT 5%	Tn	8,5	4,35
KK	29,63%	25,47%	25,48%

Source: Primary data analysis 2019

2.2. Chlorophyll

Berraaouan et.al (2017) that Alginate treatment gave an increase in the percentage of germination, plant length and chlorophyll. The results of the Anova variance test on the observation of chlorophyll in the leaves (Table 5), showed a significant effect of treatment on the observations at 56 DAP, 63 DAP and 70 DAP.

The results of the 5% BNT further test at the age of 56 DAT, 63 DAP and 70 DAP treatment of 20 g/L Sodium Alginate (S2) showed the highest number of chlorophyll units, where at 70 DAP the S2 treatment reached 46.23 units of chlorophyll, achieved by Sodium Alginate 20 g/L water (S2), higher than the control which showed the lowest number (S0). Okonkwo (1998) suggested that chlorophyll functions in the process of plant photosynthesis. Chlorophyll-forming factors are, Nitrogen, Mg, Cu, Zn, Fe, humidity, light, soil pH, and oxygen. Fageria et al., (2011) explained that nitrogen is an important factor in the formation of chlorophyll. The results of this study showed that the amount of chlorophyll in the application of 20 g/L Sodium Alginate was the optimum concentration which was significantly different from the control and S1, then S1 was the same as S3, the control showed the lowest value.

TABLE 5

Average Chlorophyll Value at Age 35 DAP to 70 DAP (Unit)

Treatment	56 HST	63 HST	70 HST
Without Sodium Alginat (S0)	40,47 ab	34,68 a	35,93 a
10 g/L Sodium Alginat (S1)	36,91 a	35,00 a	39,54 b
20 g/L Sodium Alginat (S2)	42,94 b	43,02 b	46,23 c
30 g/L Sodium Alginat (S3)	39,47 ab	41,95 b	41,75 b
BNT 5%	5,29	2,39	3,02
KK	4,28 %	7,41 %	7,23 %

Source: Primary data analysis 2019

2.3. Root Length

Root length parameters based on ANOVA variance (Table 6) showed a significant effect on the observed ages of 28 DAP, 35 DAP and 42 DAP. Age 28 DAP, showed that the highest root length was shown by treatment S1 which was not significantly different from the control and S2 (20 grams of

Sodium Alginate/L water), but not significantly different from S1 (S0 g/L sodium Alginate, while S2 did not show a significant difference with S3.

The longest root value was shown at 42 DAP by the treatment of 20 gr/L Sodium Alginate with a value of 19.26 cm which was different from the control, but the control was the same as S1, the shortest value was achieved by the S3 treatment which was significantly different from the other treatments. Roots have an important role in increasing the efficiency of N uptake (Fageria et al., 2011), the longer the root range, the wider the nutrient uptake, the results of research on the effect of encapsulation on bud chips on sugarcane root length have not been found.

Root length will determine the ability of the roots to explore the roots to absorb nutrients and water for the needs of plant life. Here we present in Table 6, the results of the further test of root length at the age of 28 DAP to 42 DAP.

TABLE 6

Average root length (cm) at the age of 28 WAP to 42 WAP

Treatment	28 MST	35 MST	42 MST
without Sodium Alginat (S0)	15,68 b	19,97 b	15,13 b
10 g/L Sodium Alginat (S1)	18,31 b	19,87 b	14,91 b
20 g/L Sodium Alginat (S2)	15,12 ab	14,12 ab	19,26 c
30 g/L Sodium Alginat (S3)	11,42 a	13,58 ab	10,13 a
BNT 5%	3,88	6,48	4,12
KK	18,53 %	29,78 %	17,16%

Source: Primary data analysis 2019

2.4 Dry Safe Weight

The results of the Anova variance test on the dry weight of the stover (Table 7), which is the accumulation of assimilate from photosynthesis, showed a significant effect on the treatment at 56 DAP, 63 DAP and 70 DAP. At the age of 56 DAP, the highest dry weight was indicated by treatment S2 which was not significantly different from S0, and S0 was not different from S1, the lowest weight was indicated by the treatment of 30 g/L Sodium Alginate. Age 63 DAP control treatment, S1 and S2 were not significantly different, but significantly different from S3 which showed the lowest value. Plant age 70 DAP, the highest dry weight was indicated by S2 which was significantly different from the control (S0), where S0 was not significantly different from S1 and S3.

The dry weight of the stover is a plant growth parameter to determine the amount of photosynthate produced and stored by plants. The weight of the fresh stover depends on the amount of water contained in the plant organs. The dry weight of the stover is the result of the net assimilation of CO2 and H2O during plant growth and development, therefore the dry weight of the stover is the most representative indicator of plant growth.

Rikardo (2015) stated that the use of polybag containers showed an increase in stem height of 32%, number of leaves 18%, stem diameter 48%, and number of tillers 51% compared to

pottray containers. The growth of sugarcane bud chips in terms of stem height, number of leaves and stem diameter was significantly better at 18 g/60 plants at a dose of fertilization. The role of root surface area and nutrients in the soil will complement each other so as to produce better stem height, number of leaves, stem diameter, number of tillers. The results of the vermicompost analysis used in this study showed the amount of N, in the high category and P, K in the very low category, entisol soil as a combination medium was generally poor in nutrients, plant growth was limited by factors that were in limited circumstances (Sufardi, 2020). This is thought to have an effect on the growth of seedlings that grow on planting media with limited nutrients and water.

TABLE 7

Average Weight Value of dry stover (grams/plant)

Treatmeant	56 HST	63 HST	70 HST
without Sodium Alginat (S0)	0,72 bc	0,80 b	0,75 b
10 g/L Sodium Alginat (S1)	0,58 b	0,68 b	0,75 b
20 g/L Sodium Alginat (S2)	0,80 c	0,70 b	1,40 c
30 g/L Sodium Alginat (S3)	0,38 a	0,40 a	0,46 a
BNT %	0,19	0,13	0,24
KK	19,23%	12,40 %	17,69%

Source: Primary data analysis 2019

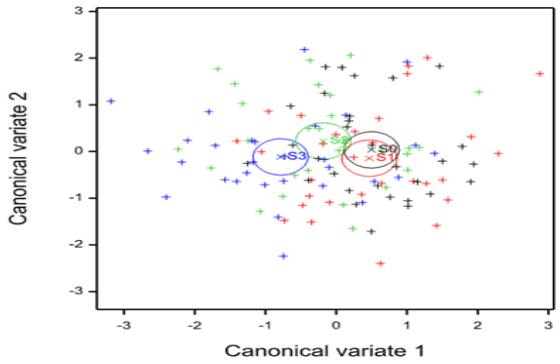

Figure 1. Analisis Multivariat terhadap Luas Daun, Klorofil, Panjang Akar dan Bobot Brangkasan kering.

Encapsulation trials on sugarcane seeds using Sodium Alginate applied to sugarcane bud chips of the CMG Agribun variety, with the aim of protecting the bud chips from damage, showed results based on the Anova Variety Print, treatment of 20 g/L Sodium Alginate (S2) gave the best results in the percentage of growth. shoots, number of leaves, plant height, leaf area,.

Based on the results of the multivariate analysis in Figure 1, the results of the multivariate analysis on destructive observation parameters, namely Leaf Area, Chlorophyll, Root Length and Dry Boiler Weight are presented, which shows the results of S0 (control) are not significantly

different from S1, S2 are significantly different from S0 and S1 , S2 is also significantly different from S3. The results of the BiPlot analysis test are presented in Figure 3, showing that of the four destructive observation parameters, namely Leaf Area, Chlorophyll, Root length and dry weight, only dry weight and root length showed a correlation with a CVA-1 value of 91.64%.

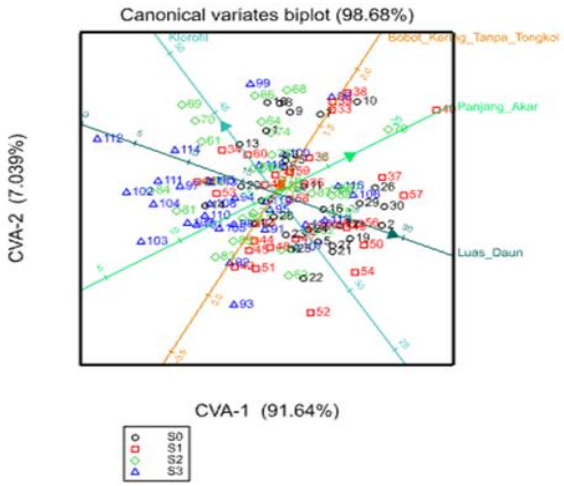

Figure 2. Biplot analysis of leaf area, chlorophyll, root length and dry weight of the stover

III. CONCLUSIONS

1. Application of Sodium Alginate at a concentration of 20 g/l water (S2) was able to produce the best effect on several growth parameters, namely the percentage of bud chip growth of 95.54%, also on the number of leaves and plant height, compared to other treatments.
2. Against destructive observations, namely chlorophyll, leaf area, root length, and dry stover weight based on the results of multivariate analysis proved that the S0 treatment (control) was not significantly different from S1 (10 g/L Sodium Alginate) while the S2 treatment (20 g/L Sodium Alginate) was significantly different from S0 (control) and S1 (10 g/L Sodium Alginate, where the treatment of S2 (20 g/L Sodium Alginate) was also significantly different from S3 (30 g/L Shodium Alginate, while the correlation strength was indicated by the parameter Root length with dry weight.

REFERENCES

1. Afcarina., Santoso M., 2017. Respon Bud Shet dan Bud Chip pada beberapa Varietas Tebu (*Saccarum Offisinarum* L). *J. Produksi Tanaman*, 8(6): 557-567.
2. Afifuddin A., Soelistiyono R.,Nugroho N., 2017. Peningkatan Pertumbuhan Bibit Bud Chip Batang Bawah Tanaman Tebu (*Saccarum Officinarum* L) melalui Perbedaan Waktu Hot Water Treatment (HWT) dan Pemberian Giberelin. *J. Produksi Tanaman,* 5(6): 932-938.
3. Anshar A.M., Wahab W.a., Daya Hambat Ekstrak Na-Alginat Dari Alga Coklat Jenis Sargassum Sp. Terhadap Proses Pematangan Buah Mangga. *Artikel Riset.* Jurusan Kimia Fakultas MIPA Unhas. https://core.ac.uk/download/pdf/25493376.pdf.

4. Badan Penelitian dan Pengembangan Pertanian. 2015. Pembenihan tebu bud- chip. Kementrian Pertanian Republik Indonesia.Badan Penelitian Pengembangan Pertanian Jakarta. p. 55-72 .
5. Berraaouan, D., Elmiz, M., Salhi, S., & Tahani, A. (2017). Effect of calcium chloride on rheological behavior of sodium alginate. In *Adv Mater Proc*. 2 (10): 629- 633.
6. Brainkart. 2017. Morphology of the stem. Article. http://www.brainkart.com/article/
7. Breemer R., Picauly P., Polnaya F.J., 2015., The Effect of Calcium Chloride and Vacuum Air on Quality of Tomato Fruit., *Journal Agritecno*. 4(2): 56-61.
8. Byjuy's. 2020. What is the function of a stem in the plant? Article. https://byjus.com/questions/what-is-the-function-of-a-stem-in-the-plant/C:/Users/DELL/Downloads/1-BAB1-PERTUMBUHANTANAMAN.pdf
9. Djumali, Khuluq AD., Mulyaningsih S.,. 2016. Pertumbuhan dan Produktivitas Tebu pada Beberapa Paket Tata Tanam di Lahan Kering. *J. Agron. Indonesia.* 44 (2) : p. 211 – 219.
10. Fageria, N.A., Moreira., 2011. The Role of Mineral Nutrition on Root Growth of Crop Plants. Tex Book. pp. 251-331.http :/Users/DELL/Downloads/PDF- Adv.Agron.Rootgrowthvs MineraNut. Diunduh 15/11/2020.
11. Gusti. 2018. Gap areal dan produktivitas sebabkan produksi gula nasional rendah. Seminar Nasional yang bertajuk Kajian Komprehensif Pergulaan Menuju Ketahanan dan Kemandirian Industri Gula Nasional, Liputan Berita UGM.Grehensonhttps://ugm.ac.id/id/berita/16111.11 September 2018.
12. Harjanti, R. A., & Tohari, S. N. H. U. 2014. Pengaruh takaran pupuk nitrogen dan silika terhadap pertumbuhan awal (Saccharum officinarum L.) pada inceptisol. *Vegetalika*, 3(2): 35-44.
13. Iffah, Dewanti, P. dan Hartatik, S. 2015. Pertumbuhan benih sintetik tebu dengan pemberian natrium alginat melalui somatik embriogenesis . *Berkala Ilmiah Pertanian*. X (X): 10-10
14. Irianti, S.,Idrawati,W., Kusumastuti, A. 2016. Respons bibit bud chip batang atas, tengah, dan bawah tebu (*Saccharum officinarum* L.) terhadap aplikasi dosis mulsa bagasse. *J. Agro Industri Perkebunan*. 5 (1): p 15-28.
15. Janniffer, C.,Da, S., Neto, A.R., Severiano. E.da., C,Fabiano, G., Silva & Dornelles, P.D. 2018. Sugarcane bud chip encapsulation for ex vitro synthetic seed formation. *J. of Agricultural Science*. 10 (4): p.104-115.
16. Kasno A, 2019. Respon Tanaman Jagung terhadap Pemupukan Fosfor pada Typic Dystrudepts Balai Penelitian Tanah, Puslitbang Tanah dan Agroklimat. *J. Tanah Trop.,* Vol. 14 (2): 111-118
17. Khuluq, D.A., Hamida, R., 2016. Taksasi produksi mata tunas sebagai benih tebu (Sacharrum officinarum L.) dengan pendekatan regresi . Balai Tanaman Serat dan Pemanis. *Informatika Pertanian*. 25 (2): 273 – 278.
18. Manahan, A., Idwar, Wardati. 2016. Pengaruh Pupuk N P K Dan kascing terhadap pertumbuhan kelapa sawit (*Elaeis Guineensis Jacq*.) Fase main nursery. Universitas Riau. *JOM Faperta*. 3.(2) : 1-9.
19. McCauley A., Jacobsen J., 2011. Plant Nutrient Functions and Deficiency and Toxicity Symptoms by, Soil Scientist. Module. https://landresources.montana.edu/nm/documents/NM9.pdf,diunduh 17/10/2020.
20. Morphology-of-the-Stem_17042/.
21. Nieves, N., Zambrano, Y., Tapia, R., Cid, M., Pina, D., & Castillo, R. 2003. Field performance of artificial seed-derived sugarcane plants. *Plant cell, tissue and organ culture*, 75(3), 279-282.
22. Okonkwo NJ., 2015., Respiration in Plant. *Article.* 110 pp. file:///C:/Users/ASUS/Downloads/BasicBiologyRespirantioninplants

23. Pastika M.M., 2018. Tanaman Tebu tanaman yang punya nilai ekonomis. Artikel.
24. Pertamawati. 2010. The responses of potatoes (Solanum tuberosum L.) explant in vitro growth in photoautorof condition. *J. Sains dan Teknologi Indonesia.* 12 (1): 31-37.
25. Prasad, N.R. 2017. Sugarcane bud chip for seed multiplication. sugarcane breeding institute indian council of agricultural research. 5 pp.
26. Purlani Edi, Diwang, H.P., Istiana, H. dan Subiyakto. 2018. Tabloid Sinar Tani. http://tabloidsinartani.com/content/read/teknik pembenihan - tebu-bud- chips/ . 2 Oktober 2018.
27. Reddy, M. C., Murthy, K. S. R., & Pullaiah, T. 2012. Synthetic seeds: A review in agriculture and forestry. *African Journal of Biotechnology*, 11(78): 14254- 14275.
28. Reddy, M. C., Murthy, K. S. R., & Pullaiah, T. 2012. Synthetic seeds: A review in agriculture and forestry. *African Journal of Biotechnology*, 11(78): 14254- 14275.
29. Rikardo, R. E., & Meiriani, F. 2015. Respons Pertumbuhan bibit bud chips tebu (Saccharum officinarum L.) terhadap dosis dan frekuensi pemberian pupuk N, P dan K pada wadah pembibitan yang berbeda. *Jurnal Online Agro-ekoteknologi*, 3(3): 1089-1098.
30. Rikardo, R. E., & Meiriani, F. 2015. Respons Pertumbuhan bibit bud chips tebu (Saccharum officinarum L.) terhadap dosis dan frekuensi pemberian pupuk N, P dan K pada wadah pembibitan yang berbeda. *Jurnal Online Agro-ekoteknologi*, 3(3): 1089-1098.
31. Salisbury, F., Ross, B., Cleon, W. 1991. Wadsworth publishing company belmont, california a division of wadsworth, Inc. 681 pp.
32. Sohail A., Abbasi K.S., Arif M., & Najam F., 2019. Encapsulation of Pumpkin Seed Oil in Alginate Capsules. *Pakistan Journal of Agricultural Research.*32 (1): 20-27.
33. Statistik Perkebunan Indonesia. 2016. Tebu 2015-2017. Direktorat Jendral Perkebunan. Kementrian Pertanian. 40 pp.
34. Sufardi. 2020. Pertumbuhan Tanaman. Book. Syiah Kuala University.
35. Sugiarta, E. 2012. Revitalisasi on farm berbasis penataan varietas pada budidaya tanaman tebu. Makalah disampaikan pada Pertemuan Teknis Berbagi Pengalaman dalam Peningkatan Produktivitas dan Efisiensi untuk Kemajuan Industri Gula Nasional. Pasuruan: Pusat Penelitian Perkebunan Gula Indonesia. p .1-19