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The Effect of Buds Location on Stem Cuttings on Sugarcane (*Saccharum Officinarum L.*) Germination

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Abstract: The purpose of the study was to determine the extent of the effect of using planting material (seeds with buds on different segments of one stem on germination in an effort to improve the quality of sugarcane cultivation techniques. This research method used a Randomized Block Design (RBD) experiment with three replications. The detail treatment was as follows: M1: budding eyes number 7b M2: budding eyes number 8, M3: budding eyes number 9 M4: budding eyes number 10, M5: budding eyes number 11, M6: budding eyes number 12, M7: budding eyes number 13, M8: budding eyes number 14, M9: budding eyes number 15. Using the Excel data analysis tool, the results showed a very significant effect on the acceleration of germination and dry weight of sprouts, as well as a significant effect on the number of leaves, number of roots, length roots, and increased wet weight due to the treatment of the location of the buds on the stem cuttings of sugarcane plants acceleration of germination and root length as well as wet weight and dry weight to The best sprouts were indicated by the treatment of the location of the 11th segment (M5) buds. The highest number of leaves and number of roots was indicated by the location of the buds 12 (M6). The acceleration of increasing the number of leaves, number of roots, root length, wet weight and dry weight of the lowest sprouts is always indicated by the location of the shoots on Section 7 (M1).
Keywords: germination; seeds; shoots; stem cutting; sugarcane

INTRODUCTION

Sugarcane (*Soccharwn officinarum L.*) is one of the potential plantation crops and has high economic value, because sugarcane has a high sugar content in the stem. National sugar production in 2013 experienced a delay of 1.77% when compared to production in 2012 with yield 7. The addition of sugarcane plantation area to 460,496 hectares, this is equivalent to white crystal sugar production of 2,390,000 tons. Even though the initial target of sugar self-sufficiency in 2014 was 5.7 million tons of white crystal sugar and adjustments have been made to 3.1 million tons so that the target. Planting area sugarcane caused by their land is planted with rice, this is why Indonesia still imports about 2 million tons of sugar every year (Y Musa et al., 2020).

The government is trying to minimize sugar imports with the National Sugar Self-Sufficiency Program. Efforts are being made to support the program by procuring a method for preparing sugar cane seeds in larger quantities and having higher quality, one of which is the use of the single bud chip method (Yunus Musa & Bahrun, 2021). Public demand for sugar continues to increase from time to time (Hariyadi & Ali, 2020). This is due to population growth and the increasing number of industries that use sugar as raw materials. The average production of sugar is 2.26 million tons per year, while consumption is around 5.10 million tons per year. This is what causes sugar production and consumption figures to show a high gap (Ullah et al., 2016).

The extensification approach in increasing sugarcane production to achieve the sugar self-sufficiency target is quite difficult to achieve, so the possibility that can be done is through a sugarcane plantation intensification program (Budi et al., 2016). One of the efforts that can be done to support the sugarcane plantation intensification program is to carry out physiological engineering of sugarcane plantations by evaluating and optimizing the germination and plant growth phases (Carr & Knox, 2011).

Sugar productivity is determined by the yield of sugarcane per clump and yield. The yield of sugarcane is influenced by the number of clumps per hectare, the number of

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stems per clump and the weight of the single stem, while the yield is determined by the cultivar, climatic conditions and the level of maturity of the plant which includes age and simultaneous ripening time used. The use of mules also requires more transportation costs because 80% of the weight of the mule is the part between segments that can be removed (Mekonnen et al., 2014).

Germination is the beginning of the growth of sugarcane plants. Germination consists of the development of sugarcane organs found in sugarcane seeds. The buds are miniature stems with growing points and leaf and root primordia that form sugarcane shoots, also in other plants like citrus (Donga et al., 2018; Purba et al., 2018). After that, the root primordia that have grown into seedling roots will function to absorb nutrients and water. Sugarcane production is a sugar raw material that is absolutely necessary. One of the causes of the decline in sugarcane productivity is problems with the use of seeds, such as sugarcane seeds used by farmers of low quality. Sugarcane seeds come from two sources, namely: conventional and tissue culture. Cultivation is sugarcane determined by the quality of sugarcane seeds, good sugarcane seeds are pure, free from pests and diseases and weeds, so they have good germination and growth acceleration (Sari et al., 2020).

Growth conditions are very necessary for shoots that grow uniformly. The buds located on the young and uncolored internodes will germinate faster than the older ones (Bassil et al., 1991). The higher you go or the lower you go, the longer it will take to germinate, because the more you go up you are too young and mushy, while the lower you get older, the possibility is that it has been damaged (Addy et al., 2017) . The use of the right number of buds is expected to obtain plants with good growth and production. One way to support the intensification program in order to achieve the expected sugar productivity, including the use of superior seeds from superior varieties, it is deemed necessary to conduct further testing on the location of the buds of seed cuttings on several sugarcane varieties in order to obtain seeds, with superior varieties (Begcy et al., 2019). So the purpose of this study from the description above was to determine the extent of the influence of the use of planting material (seeds with buds on different segments of the stem on germination in an effort to improve the quality of sugarcane cultivation techniques.

METHODS

The research was conducted in the experimental garden of the Faculty of Agriculture, Universitas Merdeka Surabaya, on Jalan Ketintang Madya VII/2 Surabaya, East Java. This research method used a Randomized Block Design Experiment (RBDE) with three replications. M1 : eye of bud number 7, M6: eye of bud number 12, M2: eye of bud number 8, M7: eye of bud number 13, M: eye of bud number 9, M8: eye of bud number 14, M4: eye of bud number 10, M9 : budding eyes number 15 and M5: budding eyes number 11. The materials used in this study were sugarcane stem cuttings with the location of the buds on the stem segment from the top to the base segment, starting from the buds number: 7,8,9, 10,11,12,13,14,15 each planting material (seedling cuttings contain one bud with the same or uniform length cuttings and planting media consists of soil composition and compost with a ratio of 2:1, polybag 35x35 cm. The tools used include, among others, hoe, trowel, pot tray, label, sprayer, weighing tool, ruler, stationery, and laboratory equipment. The data obtained were processed using an excel data processing program.

RESULTS AND DISCUSSION

Germination Acceleration

The results of statistical analysis showed that the location (number) of buds on stem cuttings had a very significant effect on the acceleration of germination of sugarcane plants.

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Table 1. Average germination acceleration (days) due to the effect of location (number) of buds on sugarcane stem cuttings

Treatment	Average of Germination Acceleration
M1 / Section 7	7.66 f
M2 / Section 8	7.33 f
M3 / Section 9	6.00 cd
M4 / Section 10	5.33 bc
M5 / Section 11	4.33 a
M6 / Section 12	4.66 ab
M7 / Section 13	6.33 de
M8 / Section 14	7.00 ef
M9 / Section 15	7.66 f
SRD 5%	0.93

Note: Numbers accompanied by letters in the same column showed no significant difference in the 5% SRD test.

Table 1 shows that the location of the buds on rus 15 (7.66 days), segment 14 (7.00 days), segment (7.33 days), and segment 7 (7.66 days) required a longer germination time. Compared to the location of the buds on the other segments. Meanwhile, the fastest time for bud germination was indicated by the treatment of buds on segment 11 (4.33 days, although it was not significantly different from segment 12 (4.66 days). This is presumed that in these segments the glucose content and physiological maturity of the eye optimum shoots were reached, so that the germination acceleration was achieved more perfectly than other segments, both at the top (7, 8 and 9) and at the base (13, 14 and 15)

According to (Nisak et al., 2017) the location of the eye buds on sugarcane stems affect germination. The buds located on the segments of the young sugar cane stalks (shoots) will germinate faster than the buds located on very old stem segments (the base). Moreover, stated that the upper segments of the sugar cane stems (young shoots) contained more glucose than the lower segments of the cane stalks (base of stems), so that the highest germination was achieved. on the upper trunk segments (Kolesnikov & Lampert, 2016).

Table 2. Average number of leaves due to the effect of location (number) of buds on stem cuttings of sugarcane plants

Treatment	Average of Germination Acceleration
M1 / Section 7	7.3
M2 / Section 8	7.7
M3 / Section 9	8.0
M4 / Section 10	8.3
M5 / Section 11	8.7
M6 / Section 12	9.0
M7 / Section 13	8.7
M8 / Section 14	8.7
M9 / Section 15	8.3
SRD 5%	0.9

Note: Numbers accompanied by the same letter in the same column show no significant difference in the SRD test 5%.

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Number of Leaves

The results of statistical analysis showed that the location (number) of buds on stem cuttings had a very significant effect on the number of leaves of sugarcane plants. Table 2 shows the results of the average number of leaves formed due to the treatment of the location of the buds on the stem cuttings of sugarcane plants having a sigmoid pattern, meaning that the treatment of shoots on the shoot segments (7, 8, and 9), the number of leaves produced was not significantly different from the yield of the number of leaves was low, then the optimum/highest number of leaves was achieved by the middle segment treatment (10,11 and 12) and then decreased again in the treatment of the base segment (13, 14, 15). It is suspected that the buds are still not fully formed or have not reached physiological maturity, even though they contain more glucose, so that glucose as energy is used more for the process of perfecting the buds. While at the base of the segment the sucrose content is more than glucose. This causes the need for glucose to wait for the disassembly of sucrose so that a lot of time is needed for the germination process and leaf formation.

According to (Pabendon et al., 2017), old sugarcane stalks contain more sucrose than glucose. In sugarcane cuttings for germination, it requires energy obtained from the addition of glucose, so the germination of the younger shoots will germinate faster than the old shoots. Furthermore, Lestari et al. (2019), argued that the highest germination rate was shown at buds number 10, 11, 14 and the yield decreased until the shoots were located at the base of the sugar cane.

Table 3. Average number of roots due to the effect of location (number) of buds on sugarcane stem cuttings

Treatment	Average of Germination Acceleration
M1 / Section 7	18.0
M2 / Section 8	23.3
M3 / Section 9	23.7
M4 / Section 10	25.3
M5 / Section 11	28.7
M6 / Section 12	30.7
M7 / Section 13	26.7
M8 / Section 14	25.7
M9 / Section 15	25.3
SRD 5%	0.9

Note: Numbers accompanied by the same letter in the same column show no difference significant at 5% SRD test.

Number of Roots

Results of statistical analysis showed that the location (number) of buds on stem cuttings had a very significant effect on the number of roots of sugarcane plants. Table 3 shows that the treatment of segment 12 (30.7) produced the most roots, although not significantly different from treatment of sections 11 (28.7) and 13 (12.7) and sections 14 (25.7). While the least number of roots was achieved by treatment of segment 7 (18.0). This was presumably because the germination process was faster so that the number of roots formed earlier than the treatment of other segments and at the end of the observation the number of roots formed was also different.

According to (Sulaiman et al., 2019), that the germination process requires energy obtained from burning food reserves in the form of glucose available in the stem, the higher the level of glucose available in the

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stem, the higher the germination power and acceleration of germination.

Root Length

Results of statistical analysis showed that the treatment of the location (number) of buds on stem cuttings had a very significant effect on the root length of sugarcane plants. In table 4 it can be seen that the mean of the longest root is presented in the treatment of segment 11 (47.3 cm) although it is not significantly different from the treatment of segment 12 (46.3 cm), segment 10 (42.0 cm), 13 (41.3 cm), 14 (39.7 cm), 15 (39.7 cm), while the average of the shortest roots was shown by the treatment of segment 7 (33.7 cm).

Table 4. Average Root Length Due to the Effect of Location (Number) of Bud on Sugarcane Stem Cuttings

Treatment	Average of Germination Acceleration
M1 / Section 7	32.7 a
M2 / Section 8	36.0 a
M3 / Section 9	36.0 a
M4 / Section 10	42.0 ab
M5 / Section 11	47.3 b
M6 / Section 12	46.3 b
M7 / Section 13	41.3 ab
M8 / Section 14	39.7 ab
M9 / Section 15	39.7 ab
SRD 5%	9.7

Note: Numbers accompanied by the same letters in the same column showed no significant difference in the 5% SRD test.

Table 5. Average wet weight and dry weight due to the effect of location (number) of buds on sugarcane stem cuttings

Treatment	Average of Sprout	
	Weight Wet	Weight Dry Weight
M1 / Section 7	52.5 a	14.8 a
M2 / Section 8	65.2 ab	19.1 ab
M3 / Section 9	67.6 ab	20.1 b
M4 / Section 10	75.6 bcd	23.9 bc
M5 / Section 11	93.0 d	32.1 d
M6 / Section 12	89.9 d	27.4 cd
M7 / Section 13	73.2 abcd	22.8 bc
M8 / Section 14	71.8abc	22.1 b
M9 / Section 15	69.9 abc	21.8 b
SRD 5%	20.9	5.1

Note: Figures accompanied by the same letter in the same column showed no significant difference in the 5% SRD test.

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Wet and Dry Weight

The results of statistical analysis showed that the location (number) of shoots on stem cuttings had a very significant effect on the root length of sugarcane plants. Table 5 shows the results of the average wet weight and dry weight of the highest sprouts produced in the M5 treatment section 11 and the lowest was produced in the M1 section 7 treatment, this is because the faster the buds germinate, the faster the formation of other sprout components, such as growth leaf roots. According to (Budi et al., 2016), that photosynthesis is the energy needed from a source of glucose, then the process of respiration (catabolism) solum, then glucose is dismantled or caused the processes of life.

CONCLUSION

There is a very significant effect on germination acceleration and dry weight of germination, as well as significant effect on number of leaves, number of roots, root length and wet weight of germination due to the location (number) of buds on stem cuttings of sugarcane plants and acceleration of germination and root length and wet weight. The dry weight of the best sprouts was indicated by the treatment of the location of the bud on segment 11 (M5). The highest number of leaves and number of roots was indicated by the treatment of the location of the bud on segment 12 (M6) and the acceleration of germination of the number of leaves, number of roots, root length, wet weight and weight. The lowest dry shoots were always indicated by the location of the buds on segment 7 (M1), Because the buds that are located on the segments of the sugar cane are still young and contain more glucose, it will germinate faster than the buds that are located on the segments of the very old stems.

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