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Two Types of Sugar Cane (*Saccharum officinarum*) Murity Varieties Productivity in Different Planting Patterns

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ABSTRACT

The two varieties, Bululawang and Cenning, exhibit different maturity types. The sugarcane production cycle involves the cultivation of Plant Cane (PC), Ratoon Cane (RC) I, and Ratoon Cane (RC) II cropping patterns, followed by replanting. The objective of this study is to assess the productivity of Bululawang and Cenning varieties when planted as plant cane and ratoon cane. QA conducted the study On Farm PG. Pesantren Baru, located in Plosokidul, Plosoklaten, Djengkol, Ploso Kidul, Kec. Plosoklaten, Kediri, East Java. It took place from July to September 2021. The study compared the two varieties under different cropping patterns. The differences in variables between treatments were analyzed using a T-test at a significance level of 5%. The observations and sample collection were conducted at specific distances from the field's edge, including line 4 (4m), line 5 (12m), line 282 (8m), line 560 (4m), and line 561 (12m). When planted as plant and ratoon cane, the T-test analysis revealed significant differences in stem weight and productivity parameters between Bululawang and Cenning varieties.

Keywords: *Bululawang, Cenning, Plant Cane, Ratoon Cane, Productivity*

1. INTRODUCTION

Sugar cane, scientifically known as Saccharum officinarum, is a significant plantation commodity in Indonesia. It plays a crucial role in meeting the basic needs of the Indonesian people, particularly in the form of white crystal sugar. Sugar cane also contributes to the food and beverage industry by producing refined sugar, which is a vital raw material. However, recent data from the Badan Pusat Statistik (2021) reveals a decline in sugar production from 2016 to 2020. On a global scale, the Pusat Data dan Sistem Informasi Pertanian (2022) reports that sugarcane productivity has experienced slight fluctuations over the past decade (2011-2020), ranging from 67.77 tons/ha to 70.99 tons/ha, with an annual growth rate of only 0.19%. In 2020. the world's sugarcane productivity reached 69.17 tons/ha, showing a slight decrease compared to the previous year. Unfortunately, Indonesia currently ranks 36th in sugarcane productivity, with a level of 67.88 tons/ha. This highlights the need for various agricultural technological innovations in Indonesia to enhance sugarcane productivity.

According to a study conducted by Atikasari *et al*., 2023. several factors can impact the productivity of sugarcane. One of these factors is the planting category used in sugarcane cultivation. The planting category can be divided into early planting or plant cane (PC) and ratoon cane (RC). Plant cane refers to sugarcane that is planted on new land or land that has been cleared after the previous harvest. Before planting, the land needs to be prepared. On the other hand, ratoon cane refers to sugarcane plants that regrow from the stem tissue left in the soil after the initial sugarcane is cut down and cleared (Fitra et al., 2020). Cultivating sugarcane through ratoon cane is more profitable than planting new sugarcane plants. This is because it requires relatively lower costs as it eliminates the need to purchase seedlings and clear land. However, it is essential to note that sugarcane cultivation may not always be profitable if the production gains are low and do not outweigh the costs involved. From a broader perspective, decreasing sugarcane production and quality can lead to declining national sugar production (Kadarwati et al., 2015).

In addition to categorizing the plants, sugarcane productivity is greatly influenced by the selection of suitable varieties and the management of the growing environment. It is crucial to carefully plan the planting of each Variety according to its maturity type to achieve high yields. Sugarcane varieties are classified into different maturity types: early, early, middle, middle, and late middle (Riajaya dan Kadarwati, 2016). (Riajaya and Kadarwati, 2016). The Bululawang and Cenning varieties are commonly used due to their distinct germination and maturity times. Bululawang has a slow germination process and reaches middle maturity slower, while the Cenning Varieties have a moderate germination rate and early intermediate maturity. High-quality sugarcane possesses specific characteristics, including a high germination rate, long stem size, lengthy internodes, a large number of stems, upright leaf angle, a moderate stem diameter, and a small number of leaves (Rokhman, 2014).

This research aimed to assess the development and efficiency of two different types of Cenning (early ripening) maturity varieties in comparison to Bululawang (late ripening) in two distinct planting categories, namely plant cane (PC) (first crop) and ratoon cane (RC) (ratoon crop).

2. MATERIAL AND METHODS

The research was conducted in Djengkol, Ploso Kidul, Plosoklaten District, Kediri, East Java. The following are the coordinates of the research

location -7.8670324.112.1445447. The research was carried out from July to September 2021.

The necessary tools include a calliper for measuring the stem diameter, a tape measure for determining the stem height, paper labels for marking the observed stems, a notebook, and writing utensils. The research focused on sugar cane, specifically plant cane (PC) and ratoon cane (RC) planting patterns that were nine months old. The planting material originated from mules/cuttings. The varieties examined in the study were Cenning an early maturity type, and Bulu lawang (BL), a late maturity type. Early maturing varieties enter the generative phase after one month of exposure to dry months (rainfall < 60 mm). In contrast, late-ripening varieties require more than three months of dry conditions to enter the generative phase. The observations were conducted at specific distances from the edge: the 4th sample was taken 4 meters from the edge, the 5th sample was taken 12 meters from the edge, the 6th sample was taken 282 meters from the edge, and the 7th sample was taken 560 meters from the edge. The 3rd sample was taken on the 561st ledge, 12 meters from the edge.

Two different types of varieties were compared under two distinct cropping pattern conditions during this research. The analysis employed the T-test to examine the differences between treatments in a single direction, with a significance level of a = 5%. The observed parameters included the number of plants, tillers, plant height, number of segments, length of segments, stem diameter, stem weight per meter, and productivity. The counting of plants per meter was conducted before harvest. Tiller counts were recorded every week until the conclusion of the study. Plant height observations were made once a week until the end of the research. Monitoring of stem diameter occurred every week. The number of segments was counted weekly until the research was completed, with observations covering the stem's base, middle, and tip segments. Segment length calculations were performed weekly until the end of the study, encompassing the stem's base, middle, and tip. Stem diameter was measured using a calliper at a height of 10 cm from the ground surface, with observations made at the stem's base, middle, and tip. The final observation after harvest involved weighing the sugar cane using a scale. Observations were made at the stem's base, middle, and tip. After conducting the calculations mentioned above, the data can be utilized to estimate the quantity of sugarcane production by multiplying the number of stalks per plot by the weight of sugarcane per stalk.

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3. RESULT AND DISCUSSION

The growth and development of sugar cane plants goes through 5 phases, namely the germination phase, sprouting phase, stem elongation phase, sugar filling phase, and maturity phase. In the sprouting phase, the number of plants per meter and saplings.

Table 1. Parameters for the number of plants and tillers per meter of sugarcane between 2 varieties with different planting patterns

Varieties	Planting Pattern	Total Plant (per meter)	Total tillers (per meter)
Bululawang	Plant Cane	8.0 ± 1.00 a	39 ± 8.6 a
	Ratoon Cane	8.0 ± 1.00 a	34.3 ± 7.4 a
Cenning	Plant Cane	7.7 ± 0.57 a	39 ± 9.5 a
	Ratoon Cane	7.7 ± 0.57 a	23 ± 6.9 b

Note: The same letters in the same column indicate no significant difference.

No significant differences were observed in plant germination parameters between the two varieties and two planting patterns. However, the number of shoots in the Cenning Varieties with the ratoon cane planting pattern showed a significant difference compared to the same sugarcane Varieties, Cenning, but with a different planting pattern, namely plant cane and other varieties. Other Varieties, bulu lawang, also exhibited two planting patterns: plant cane and ratoon cane. During the budding phase, the number of plants refers to the parent plant grown from the buds of the stem cuttings planted in rows. On the other hand, the number of tillers plays a crucial role in calculating sugarcane productivity, as it is one of the components of sugarcane productivity (Hamida et al., 2022).

The parameter used to estimate the number of sugarcane stalks harvested in the cultivated area is the number of tillers. The provided table shows that both varieties and planting patterns have 7 to 8 mother plants growing in a 1-meter area, with each mother plant having 3 to 5 tillers. The total number of sugarcane plants maintained until they reach 10 to 12 months of age is another parameter used to calculate the productivity of sugarcane plants in a 1-hectare field. In the table displaying the number of tillers, the Cenning Varieties in the ratoon cane planting pattern exhibit a significant difference compared to the same Varieties in the plant cane planting pattern and the Bululawang Varieties in both planting patterns. The number of tillers in the Cenning Varieties is notably low when grown in the ratoon cane planting pattern. This can be attributed to a decrease in food reserves stored in the sugarcane stem clump, resulting in new shoots relying on external factors such as soil and climate conditions and cultivation management. The formation of sugarcane tillers primarily occurs around the main stem. External factors, particularly farm management, greatly influence the success of sugarcane budding. On the other hand, internal factors encompass the quality of sugarcane seedlings containing glucose, nitrogen, and water (Zaini et al., 2017). Food reserves in sugarcane are stored in the stem. One factor determining the quality of planting material is the amount of substrate, such as carbohydrates, available for metabolism that supports early plant growth. In addition, the wound part of the former cutting greatly affects the water loss in the seed and can be a way for pathogens to infect the seed tissue during storage (Annisa et al., 2015).

Table 2. Parameters of plant height, internode length and number of segments per sugarcane plant between 2 varieties with different planting patterns

Varieties	Planting Pattern	Plant Height (meter)	Segment length (per Plant)	Total Segments (per plant)
Bululawang	Plant Cane	2.87 ± 0.50 a	12.3 ± 1.3 a	35.3 ± 1.09 a
	Ratoon Cane	2.60 ± 0.65 b	10.7 ± 0.8 ab	35.3 ± 1.78 a
Cenning	Plant Cane	2.83 ± 0.65 a	11.3 ± 0.7 ab	33.3 ± 2.19 a
	Ratoon Cane	2.77 ± 0.5 a	10.3 ± 0.5 b	33.3 ± 2.28 a

Note: The same letters in the same column indicate no significant difference.

There is a notable distinction in the stem growth parameters of sugarcane plants, particularly in the height of sugarcane varieties with ratoon cane (RC) planting patterns compared to the plant cane (PC) planting pattern in the Bulu Lawang Varieties. Additionally, both planting patterns in the Cenning Varieties exhibit a significant height difference. However, when it comes to the length of internodes per plant, the Cenning Varieties with RC planting patterns show a significant difference compared to the PC planting pattern in the Bulu Lawang Varieties. Interestingly, no significant difference was observed between the PC and RC planting patterns in the Bulu Lawang Varieties for the Cenning Varieties. Furthermore, the number of internodes per plant does not show a significant difference in the Lawang feather Varieties for both PC and RC patterns and the Cenning Varieties for both PC and RC planting patterns. It is important to note that the relationship between plant height is influenced by the length and number of internodes in sugarcane plants, which are affected by the genetic factors of the varieties used (Supriyadi et al., 2018). The number of internodes per stem is vital in yield because it relates to plant height. Broadly speaking, the height of sugarcane plants is determined by the number of internodes and the length of sugarcane stem internodes, and the growth of sugarcane internode length occurs during stem elongation (Muttaqin et al., 2016).

Plant height is determined by plant assimilation, essential for vegetative growth. In the case of sugarcane plants, their height plays a crucial role in deciding their future productivity. The height and uniformity of the plants directly influence the productivity of sugarcane. According to Muttaqin et al. (2016), the better the growth and uniformity of the sugarcane plants, the higher the productivity will be. Plant height, specifically the increase in the size of the plant stem towards the top (apical), is one of the indicators of vegetative growth in sugarcane plants. This increase in stem height results from the plant's age, which leads to a rise in the number of cells and phytohormones in the stem. Table 2 shows that the Bululawang Varieties of sugarcane, when planted using the ratoon cane pattern, have the lowest height compared to the same Varieties planted using the plant cane pattern, as well as other varieties with different planting patterns. This height difference is influenced by the length and number of segments in each variety, based on the plant cane and ratoon cane planting patterns. The length of the internodes is a parameter used to measure plant height. Ideally, the length of sugarcane stem segments should be between 15 and 20 cm, depending on the varieties and environmental conditions. However, under dry environmental conditions, the segment elongation may be suboptimal, resulting in lengthening that is less than 10 cm. If the segments are short, the plant height is not achieved optimally. Meanwhile, the number of segments can be used to determine the age of the plant. The increase in sugar cane stem segments in 1 month reaches 2 - 3 segments. Regarding internode length parameters, the Cenning Varieties with the Ratoon cane planting pattern have shorter internode lengths than the Bululawang Varieties with the cane plant pattern. The limited food reserves influence this in the ratoon cane stems of the Cenning Varieties. It is also affected by dry environmental conditions, which cause the elongation of internodes to be hampered. The Cenning Varieties is an early maturity type so physiologically. It cannot withstand conditions of low soil moisture content (< 50 %) or dry months (rainfall < 60 mm) for one month.

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Table 3. Parameters of stem diameter, stem weight per meter and sugarcane productivity between 2 varieties with different planting patterns

Varieties	Planting Pattern	Stem Diameter (mm)	Stem Weight (Kgs per meter)	Productivity (tons per hectare)
Bululawang	Plant Cane	31.0 ± 2.3 a	0.47 ± 0.023 a	93.8 ± 10.3 a
	Ratoon Cane	26.7 ± 1.67 b	0.44 ± 0.015 b	77.9 ± 12.4 ab
Cenning	Plant Cane	32.3 ± 0.8 a	0.47 ± 0.008 a	91.9 ± 8.6 a
	Ratoon Cane	26.7 ± 1.3 b	0.40 ± 0.008 c	71.0 ± 5.0b

Note: The same letters in the same column indicate no significant difference.

Table 3 reveals significant variations in stem diameter parameters between the two planting patterns (PC and RC) for the two varieties. The Bululawang and Cenning varieties exhibit a larger diameter when planted using the PC pattern than the RC pattern. Stem diameter plays a crucial role in the growth of sugar cane plants as it directly impacts the yield. According to the research conducted by Annisa et al. (2015), the PS 862 clone demonstrated a larger stem diameter than the Bululawang clone. Sugar cane with a larger trunk diameter can store greater water and food reserves. Diameter also serves as a vital parameter in assessing the effects of treatments on plant growth and can be utilized to determine sugarcane production (Siswanto et al., 2019). Stem diameter is a significant characteristic in determining the development of sugarcane. The storage of glucose and carbohydrates, which are the products of photosynthesis, occurs in the sugar cane stalks. Stems with a larger diameter will contain higher quantities of glucose and carbohydrates (Kadarwati, 2020).

The research of Riajaya and Kadarwati (2016) shows that stem weight and stem diameter have a very close and positive correlation. The higher the stem diameter, the higher the stem weight. Stem weight per meter is closely related to stem diameter. The greater the stem diameter, the higher the stem weight. This causes the stem weight to also show a real difference, especially the weight of the stem per meter of sugar cane Varieties. Cenning with the ratoon cane pattern has the lowest weight per meter compared to the weight of the stem per meter of the Bululawang Varieties in the same planting pattern, namely ratoon cane. The ratoon cane planting pattern in both varieties shows a significant difference from the plant cane planting pattern in both varieties. The weight of the ratoon cane of both varieties is still lower than the weight of the stem compared to that of the plant cane. This is thought to be influenced by the varieties used, following the results of research by Chohan et al. (2014), which showed differences in stem weight produced due to differences in sugarcane clones/varieties used. By knowing the stem's diameter, the sugarcane stem's weight will be obtained. This is useful in making estimates of sugarcane productivity without destructive plants. Therefore, the productivity parameter of Cenning varieties with ratoon cane planting patterns significantly differs from that of Cenning and Bululawang varieties.

The productivity parameter demonstrates the most favorable outcomes in Bululawang when utilizing the Plant cane planting pattern. This can be attributed to the Plant Cane planting pattern involving the initial crop, which maintains its productivity without any decline. The initial crop (PC) tends to exhibit a higher productivity rate than the ratoon crop, and this productivity tends to decrease due to less optimal land conditions in subsequent crops. The first crop benefits from favorable soil aeration,

as the time interval between tillage and sugarcane growth, is relatively short. Consequently, this disparity in productivity between the first crop and the subsequent crops is consistent with Riajaya and Kadarwati's (2016) findings. Their study revealed early to early middle varieties, such as PS 881. Cenning, and PSJK 922. yielded a productivity range of 93-96 tons/ha. Additionally, late intermediate varieties, including VMC-7616 and PSDK 923. achieved a productivity range of 105-109 tons/ha. Notably, varieties with a middle-slow maturity type attained the highest level of sugarcane productivity. Among these varieties, PSDK 923, with the mid-slow maturity type, exhibited the highest productivity of 109.28 tons/ha, surpassing the widely used BL Varieties (92.98 tons/ha) in various regions.

4. CONCLUSION

1. The number of tillers in the ratoon cane planting pattern has shown a significant decrease in the Cenning Varieties compared to the plant cane planting pattern. Furthermore, this decrease is also observed in comparison to the Bululawang Varieties in both planting patterns.
2. In the ratoon cane planting pattern, the Bululawang varieties exhibit the lowest plant height, as opposed to the Bululawang varieties in the plant cane planting pattern and the Cenning varieties in both planting patterns. Additionally, the internode length in the Cenning varieties with the ratoon cane planting pattern is the shortest compared to the Bululawang varieties with the plant cane planting pattern.
3. The stem diameter of both varieties with the ratoon cane planting pattern displays a smaller stem circumference in comparison to the plant cane planting pattern. Moreover, the stem weight per meter of the Cenning Varieties with the ratoon cane planting pattern is the lightest compared to the Bululawang Varieties with the ratoon cane planting pattern. Notably, both varieties in the ratoon cane planting pattern are lighter than those in the plant cane planting pattern.
4. The productivity of the Cenning Varieties in the ratoon cane planting pattern is the lowest compared to the same Varieties in the plant cane planting pattern and the Bululawang Varieties in both planting patterns.

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