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Production Growth Response of Two Sugar Cane Varieties (*Saccharum officinarum L.*) At Available Various Water Levels

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***Abstract*— *This study on available water content aims to determine the ability of sugarcane plants to grow and produce under water-stressed conditions. This research is expected to be used as one of the references in making decisions to use water efficiently in the Takalar sugar factory's sugarcane plantations. The study used two varieties of sugar cane namely PS. 61 and Q 81. The two varieties were planted at various moisture content levels, namely 25-50%, 50-75%, and 75-100%. The results showed that having 50-75% available water content had a better effect on sugarcane growth during the dry months of September and October. The Q 81 variety is better able to utilize the limited water supply for growth and production. The amount of available water and the variety of growth and sugarcane production have a significant interaction*.

I. INTRODUCTION

Sugarcane (Saccharum officinarum L.) is a major sugar-producing plant. Sugar cane sugar is an important commodity because it is one of society's nine basic needs. The growing population necessitates an increase in the community's need for sugar consumption. This increase must be accompanied by an increase in sugar cane cultivation in order to meet the community's sugar needs. Takalar sugar factory has a large sugar cane cultivation area. Water availability is a major issue in this plantation area. From November to April, rainfall is uneven and concentrated, with a long and distinct dry season from May to October.

The main issue in efforts to increase sugarcane productivity in the Takalar sugar factory's sugarcane plantation area is the short rainy season with strict dry months, combined with soil conditions with low water holding capacity. Sugarcane productivity has averaged 49.24 t/ha since 1987, with a crystal content of 3.99 t/ha and a yield of 9.43%.

This low productivity is due to the fact that plants' water requirements are solely met by rainfall. Because the new plants (plant cane) had to be cut down before they gotten older, the weight and yield of the cane were relatively low.

To avoid this, the plants are planted at the appropriate time. The accuracy with which the time of planting and harvesting is determined defines the high or low weight of sugarcane and its yield. Because of this, approximately 70% of the sugar cane planting in the Takalar sugar factory plantations occurred in August, September, and October, despite the fact that water availability was extremely limited at the time.

So far, most research has concentrated on the use of water resources in dry-land sugarcane plants with irrigation systems, with little emphasis on the efficient use of water during dry months for sugar cane growth and production. Given the condition of the Takalar sugar factory land, which ranges from flat to undulating with quite high rainfall during the rainy season, the rain water that flows on the surface (run off) in Lampung is used as irrigation water through dams to be used during the dry season. However, the amount of water that can be accommodated has not been able to meet the needs of plants during the dry season, making it difficult to cultivate plants.

PS 61 and Q 81 sugarcane varieties were developed at the Takalar sugar factory. Both varieties have adapted well to their surroundings. This ability can be capitalized on by creating favorable conditions for growth and production.

II. RESEARCH PURPOUSES

This study on available water content aims to determine the ability of sugarcane plants to respond to limited water availability in determining their growth and production.

III. RESEARCH METHODS

This research was conducted in Parangpungata Village, Polong Bengeng Utara District, Talakar Regency. This research was carried out in the form of an experiment arranged according to a Split Plot Design in a random group pattern. The main plot consisted of two varieties, namely PS 61 and Q 81 (V_2). Subplots are available concentration levels that consist of three levels, namely the 25-50% available concentration level (K_1). 50-75% (K_2) and 75-100% (K3). The main and sub-plot combinations are:

V_1K_1 V2K1

IN1K_2 V2K2

IN1K3 IN2K3

Each combination was divided into three groups, yielding a total of 18 experimental plots. Each unit is 12x10 meters in size, or 120 m2. Water requirements are calculated using field capacity of 40%, permanent wilting point of 27%, and soil density of 1.39 cm3.

As a result, the water available for sugarcane crops ranges between 27 and 40%. The water contains four levels of water content, which are as follows:

a. 25% of the water is available, then the soil water level is 0.25 x 13=3.25%
b. 50% of the available water, then the soil water content is 0.50 x 13 = 6.50%
c. 75% of the available water, then the soil water content is 0.75 x 13 = 9.75%
d. 100% of the water is available, then the soil water content is 0.25 x 13 = 13.00%

The supplied water is calculated using the following equation:

$$W_{SI} = 0,1 \text{ X hi } \frac{\sum SI}{W} \text{ X WWI}$$

W_{SI} = Soil sleeve expressed in units of water deviation from the 1st layer (mm)

Hi = Thickness of the 1st layer of soil (cm)

∑SI = Density or dry weight of soil volume from the 1st field (9cm^3)

WWI = Soil sleeve from the 1st layer (% by weight).

The amount of water for each level of water content is calculated using this equation as follows:

a. 25% of available water, = 3.9 x 3.25 =12.675 mm/m² or 1521 1/plot
b. 50% of available water, = 3.9 x 6.50 = 25.350 mm/m² or 3042 1/plot
c. 75% of available water, = 3.9 x 9.75 = 38.250 mm/m² or 4563 l/plot
d. 100% of available water, = 3.9 x 13.00 = 50,700 mm/m² or 6084 l/plot

As a result, the amount of water required for each treatment can be calculated. Since the increase (%), the number of tillers, stem height, stem diameter, number and length of internodes, stem length, number of stems, sugarcane weight per stalk, and sugarcane yield (%) have all been observed.

IV. RESULT AND DISSCUSSION

The experimental results revealed that the amount of available water content and its interaction with varieties had a significant effect on the number of tillers at 30 HST, plant height at 30 HST, stem diameter at harvest, and number of internodes, but only had a minor effect on internode length and sugarcane yield. The analysis revealed that the highest number of tillers and plant height for both varieties occurred at water availability levels of 50-75% and 75-100%. At the same moisture content levels of 50-75% and 75-100%, stem diameter and internode length showed the same interaction results (Tables 1 and 4). Cane internode length and yield showed varying tendencies. For segment length, water content levels of 25-50% and 50-75% outperform moisture content levels of 75-100%, whereas for sugarcane yield, available water content levels of 25-50% and 75-100% have a negative effect. superior to 50-75% water content (Tables 5 and 6).

The two sugarcane varieties tested yielded varying growth and production results. The components of tiller number, plant height, and internode length (Tables 1, 2, and 5) revealed that the PS 61 variety outperformed the Q 81 variety. In terms of stem diameter, internode number, and sugarcane yield, the Q 81 variety performed better than the PS 61 variety (Tables 3,4, 6).

Table 1. Average number of tillers per meter at 30 HST

Variety	Level of water		
	K_1	K_2	K_3
V_1	$4{,}19^{b}{}_{x}$	$4{,}60^{a}{}_{x}$	$4{,}66^{a}{}_{x}$
V_2	$4{,}19^{c}{}_{x}$	$4{,}36^{b}{}_{y}$	$4{,}50^{a}{}_{y}$
BNJ α = 0,05		V= 0,014	K= 0,060

In the BNJ test, numbers followed by letters that are not the same are significantly different in rows (a, b) and columns (x, y) = 0.05

Table 2. Average Total Plant Height (cm) Age 30 DAP

Variety	Level of water		
	K_1	K_2	K_3
V_1	$17{,}84^{c}{}_{x}$	$21{,}18^{b}{}_{x}$	$26{,}21^{a}{}_{x}$
V_2	$18{,}96^{a}{}_{x}$	$19{,}51^{a}{}_{y}$	$20{,}14^{a}{}_{y}$
BNJ α = 0,01		V=1,90	K= 1,26

Numbers followed by letters that are not the same are significantly different in rows (a, b) and columns (x, y) in the BNJ test α = 0.01

Table 3. Average Stem Diameter (cm)

Variety	Level of water		
	K_1	K_2	K_3
V_1	$2{,}75^{a}{}_{x}$	$2{,}77^{b}{}_{x}$	$2{,}73^{c}{}_{x}$
V_2	$2{,}79^{a}{}_{y}$	$2{,}81^{b}{}_{y}$	$2{,}82^{c}{}_{y}$
BNJ α = 0,05		V= 0,007	K= 0,0015

Numbers followed by letters that are not the same are significantly different in rows (a, b) and columns (x, y) in the BNJ test α = 0.05

Table 4. Average Number of Segments at Various Levels of Available Moisture Content

Variety	Level of water		
	K_1	K_2	K_3
V_1	$19{,}73^{a}{}_{x}$	$19{,}93^{a}{}_{x}$	$20{,}30^{a}{}_{x}$
V_2	$21{,}56^{a}{}_{x}$	$21{,}20^{a}{}_{x}$	$2{,}40^{b}{}_{y}$
BNJ α = 0,01		V=1,1	K= 1,85

Numbers followed by letters that are not the same are significantly different in rows (a, b) and columns (x, y) in the BNJ test α = 0.01

Table 5. Average Segment Length of Two Sugar Cane Varieties (cm)

Variety	Level of water		
	K_1	K_2	K_3
V_1	13,15	13,25	12,43
V_2	11,65	12,19	11,01
	$12{,}40^{a}$	$12{,}72^{a}$	$11{,}72^{b}$
BNJ α = 0,01		NP= 0,50	

Numbers followed by letters that are not the same differ greatly in the BNJ test α = 0.01

Table 6. Average Yield of Two Sugar Cane Varieties (%) at Various Levels of Available Moisture Content

Variety	Level of water		
	K_1	K_2	K_3
V_1	10,20	8,76	10,02
V_2	8,33	9,26	10,46
	$9{,}265^{c}$	$9{,}010^{b}$	$10{,}24^{a}$
BNJ α = 0,01		NP= 0,9	

Numbers followed by letters that are not the same differ greatly in the BNJ test α = 0.01

Sugarcane requires a lot of water to grow. Water availability in sufficient quantities can assist plant metabolic processes in meeting the needs for optimum growth.

The experimental results show that 50-75 percent available water and 75-100 percent available water are adequate amounts to aid plant metabolic processes. A water content of 25-50 percent produces better results for shoot formation and plant height in early growth. According to Barnes (1974), sugar cane grows optimally when the moisture content is between 50 and 75 percent of the field capacity. Water availability in sufficient quantities in plant tissues where cell division occurs will promote plant growth. Ambo Ala, 1995, also mentioned that having enough water available at the start of germination will help the sprouts grow faster.

At a moisture content of 25-50 percent of available water, initial growth is inhibited. It is suspected that the scarcity of water inhibits metabolic processes, affecting plant growth. Sugarcane plant growth and development are determined by the availability of water in the soil. When soil water content is low, water moves more slowly into plant cells, limiting the amount of food reserves that can be translocated (Rahman, 1997).

Variety and the level of available moisture content have a significant influence on production components. The effect, however, differs widely. The effect is less favorable during the rainy season because the limited availability of water at the start of growth is no longer significant for production components.

At various levels of available moisture content, the PS 61 variety was more volatile in growth and production. In terms of the number of tillers and plant height, the higher the water content, the better the growth, whereas the stem diameter, internode length, and yield of Q81 experienced growth and production improvements at each available water content level. The higher the water content, the better and more rapid the growth. This variety can survive in environments with limited water availability, and when water availability is optimal, it will be optimally utilized to spur growth and production. As a result, the two species have different abilities in utilizing water availability to spur growth and production.

V. CONCLUSION

1. The level of available water content of 50-75 percent can have a good effect on the growth of sugarcane plants.
2. 2. The Q81 variety is better suited to utilizing the limited water supply for sugarcane growth and production.
3. The level of available water content and variety have a significant impact on sugar cane growth and production.

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