

STUDY ON WATER APPLICATION FOR SUGARCANE U-THONG 3 VARIETY BY USING ET/E RATIO AND SUBSURFACE DRIP

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ABSTRACT

Study on Water Application for Sugarcane U-Thong 3 variety by using ET/E ratio and subsurface drip was conducted at the Irrigation Water Management Experiment Station 5 (Mae Klong Yai), Kamphaengsaen District, Nakhon Pathom Province from February 28, 2003 to January 7, 2004 which was 314 days by age. The objectives of this study were firstly to study the use of subsurface drip irrigation for sugarcane planting, secondly to study the water requirement suitable for obtaining maximum production by using of ET/E ratio, and thirdly to use as data for increasing sugarcane production and irrigation efficiency. The soil property is clay loam (CL) with field capacity (Fc) of 18.2%, permanent wilting point (Pwp) of 7.4%, available moisture content (Am) of 10.8%, bulk density of 1.54 and infiltration rate (I) of 100 mm/hr. The sugarcane was irrigated every 7 days by subsurface drip with the discharge of 1.6 l./hr./dripper at 1.0 bar. In this study there were 5 treatments according to ET/E ratio. Treatment 1, ET/E=1.2 or 42 mm of water, Treatment 2, ET/E=1.0 or 35 mm, Treatment 3, ET/E=0.8 or 28 mm, Treatment 4, ET/E=0.6 or 21 mm and Treatment 5, ET/E ratio varied with the growth period respectively. The result showed that the subsurface drip can be used well with sugarcane planting. The sugarcane can get water evenly as planned and for the average yields of treatment 1,2,3,4 and 5 were 170, 140,140,100 and 110 tons/ha. respectively, which the sugarcane received total water in 5 treatments were 1,680, 1,440, 1,214, 938 and 1,122 mm with the average of 5.33, 4.58, 3.85, 2.98 and 3.56 mm/day and the water use efficiency (Ey) or harvested yield per unit of water were 10.31, 9.52, 11.33, 10.31 and 9.86 kg/m³ respectively.

Key words: Subsurface Drip, sugarcane, ET/E, U-Thong 3 variety, Irrigation Efficiency, Sugarcane Production

INTRODUCTION

In the year 2004, Thailand was the fourth country of the world for sugar and molasses exporter, having the annual incomes over 30,000 million Baht. Compared with other countries, the sugarcane production per hectare was rather low at 60 tons/ha in average. Presently, Thailand has the sugarcane planting areas about 1,000,000 ha, with the total production of 65 million tons. There are 46 sugar factories in various regions, which can produce sugar about 6 million tons per year.

At present, Thailand is facing the problem on competition potential since the capital cost is high while the production per hectare is low. To encourage the competition in the international trading, it is necessary to accelerate the improvement of sugarcane production efficiency by increasing the yield.

To achieve the improvement of sugarcane production efficiency of Thailand, the Royal Irrigation Department by the Irrigation Water Research Group conducted the experimental study based on the assumption that the water is safely, timely and properly irrigated, the sugarcane production and water use efficiency both in and outside irrigated areas and in the water shortage area will be increased. If the result of study conforms to the assumption, it will be used as data or reference to consider the suitability and possibility for further practice of farmers or other concerned agencies.

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OBJECTIVES

- To study the use of subsurface drip irrigation (Arunvadee,1999) for sugarcane planting
- To study the water requirement suitable for maximum production.
- To use as database for increasing sugarcane production and irrigation efficiency.

METHODOLOGY

Equipments

- Centrifugal pump, 2 horsepower, maximum discharge of 39 m³/hr and maximum head of 19 m.
- Gravel-sand filter, maximum filter rate of 10 m³/hr.
- Grooved disc filter, fine mesh No. 150 and maximum filter rate of 10 m³/hr.
- Fertilizer injectors tank, fertilizer discharge of 80 litre/hr.
- Integral thin walled dripper line, wall thickness of 0.25 mm (10 mil), inside diameter of 16 mm the discharge of 1.60 litre/hr/dripper at 1.0 bar and the space of 0.30 m between drippers.

Sugarcane variety

The U-Thong 3 variety (Suphanburi Field Crops Research Center), which was bred between U-Thong 1 and U-Thong 2 variety. was used in the study. The prominent characters are high production by weight and quantity of sugar. Particularly in the sandy loam area, the production by weight is 100 tons/ha.

Study area

The study area is at the Water Management Experiment Station 5 (Mae Klong Yai) in Kamphaengsaen District, Nakhon Pathom Province, at latitude 13° 57' 09" N, longitude 99° 58' 02" E and altitude +7.800 m MSL. The average evaporation (E) for Class A Pan is 5.0 mm/day (Irrigation Water Management Experiment Station 5 (Mae Klong Yai), 2003; Sawai, 1971) The study plot is 52 m wide by 100 m long, divided into 5 sub-plots (Treatment 1-5) of sugarcane with 10.4 x 100 m each. The space between plots is 4.0 m. Each plot contains 8 furrows of 30 cm wide, 30 cm deep and 100 m long. The space between furrows is 1.30 m. The total planting area is 5,200 sq.m **"Figure 1-3"**.

Methodology

- Treatment 1 - water supplied every 7 days by using ET/E* (Irrigated Agriculture Branch, 1997) = 1.2 or depth of water = 42 mm.
- Treatment 2 - water supplied every 7 days by using ET/E = 1.0 or 35 mm.
- Treatment 3 - water supplied every 7 days by using ET/E = 0.8 or 28 mm.
- Treatment 4 - water supplied every 7 days by using ET/E = 0.6 or 21 mm.
- Treatment 5 - water supplied every 7 days by using ET/E ratio varied by growth period shown as **"Table 1"**

* ET/E = ratio between evapotranspiration (ET) and evaporation (E)

when : ET = evapotranspiration or water requirement of sugarcane (mm/day)

E = 5.0 mm/day (average evaporation data from American Class A Pan of the Mae Klong Yai Water Management Experiment Station (1992-2002))

Table 1. Depth of water varied by growth period for Treatment 5

Month No.	1	2	3	4	5	6	7	8	9	10
Depth of water – mm	13	18	26	33	35	33	30	27	21	11

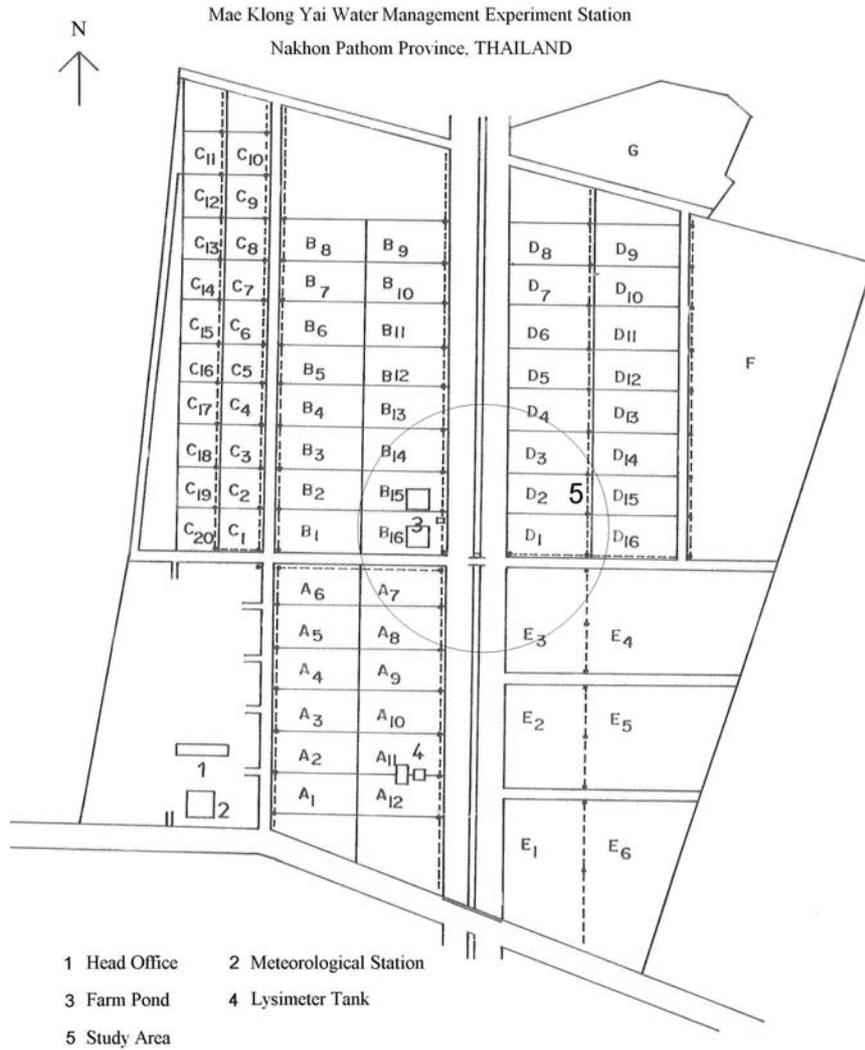


Figure 1. Lay out of study area

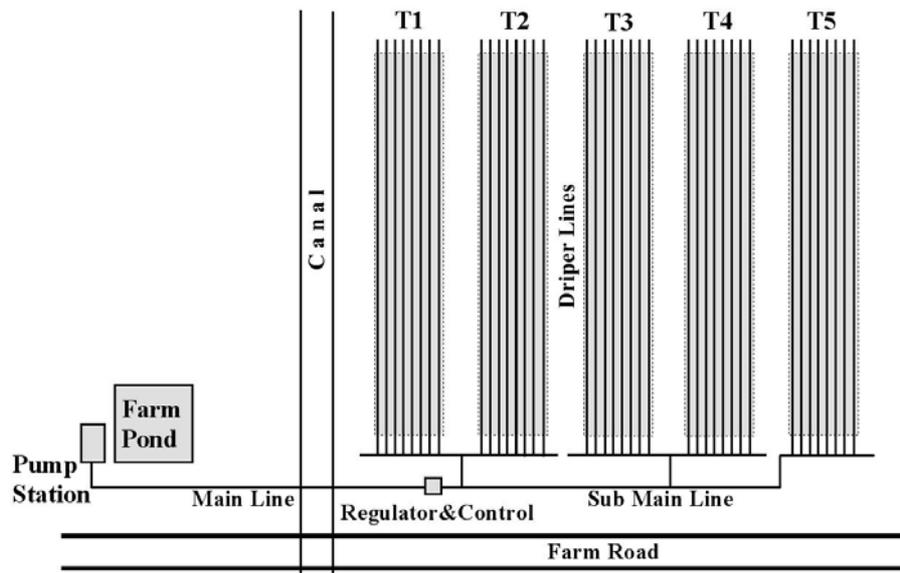


Figure 2. Plan of sugarcane planting plots and drip irrigation system

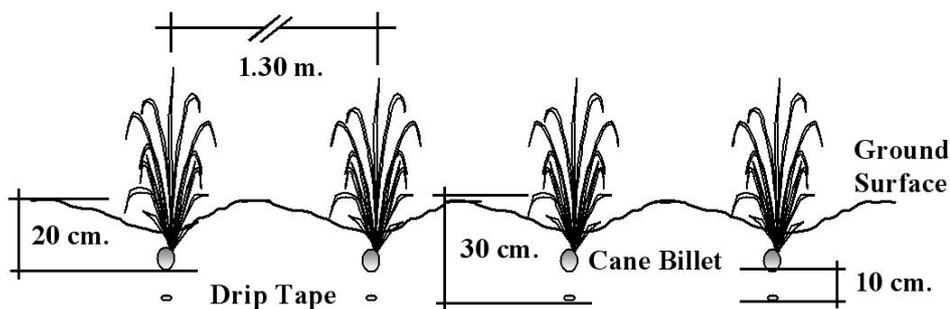


Figure 3. Lay out of plantation and subsurface drip installation

Study period

The study was started from February 28, 2003 and completed on January 7, 2004 totaling 314 days.

RESULTS AND COMMENTS

Soil property

The soil in planting plot is clay loam (CL). The average moisture at the field capacity (Fc) level is 18.2% by weight, and average moisture at the permanent wilting point (Pwp) level is 7.4%. The available moisture content (Am) is 10.8% and the average bulk density (Db) or appearance specific gravity (As) is 1.54.

The infiltration rate and accumulated depth (Asian Technology Institute, 1981; Wiboon, 1983; Thaweewat, 1984; Chessada, 1984) measured by using Double Rings Infiltrometer type are $420 \text{ t}^{-0.33}$ mm/hr and $10 \text{ t}^{0.67}$ mm respectively.

Result of study

- Treatment 1 - water supplied by using ET/E = 1.2, the sugarcane production was 170 tons/ha, the average water quantity received by sugarcane was 5.35 mm/day and water use efficiency (Ey) was 10.31 kgs/m³.
- Treatment 2 - water supplied by using ET/E = 1.0, the sugarcane production was 140 tons/ha, the average water quantity received by sugarcane was 4.69 mm/day and water use efficiency (Ey) was 9.52 kgs/m³.
- Treatment 3 - water supplied by using ET/E = 0.8, the sugarcane production was 140 tons/ha, the average water quantity received by sugarcane was 3.90 mm/day and water use efficiency (Ey) was 11.33 kgs/m³.
- Treatment 4 - water supplied by using ET/E = 0.6, the sugarcane production was 100 tons/ha, the average water quantity received by sugarcane was 3.07 mm/day and water use efficiency (Ey) was 10.31 kgs/m³.
- Treatment 5 - water supplied by using ET/E ratio varied by growth period, the sugarcane production was 110 tons/ha, the average water quantity received by sugarcane was 3.64 mm/day and water use efficiency (Ey) was 9.86 kgs/m³.

Table 2. Summary of water quantity supplied for sugarcane and productions throughout the study period

Treatment	ET/E	Water Quantity Received by Sugarcane – mm				Production Tons/ha
		Irrigation Water	Eff.Rain*	Total	Average/day	
1	1.2	1,233	453	1,686	5.35	170
2	1.0	1,044	435	1,479	4.69	140
3	0.8	808	421	1,229	3.90	140
4	0.6	566	402	968	3.07	100
5	Growth Period	733	414	1,147	3.64	110

* Effective Rainfall for field crops (Wiboon, 1983)

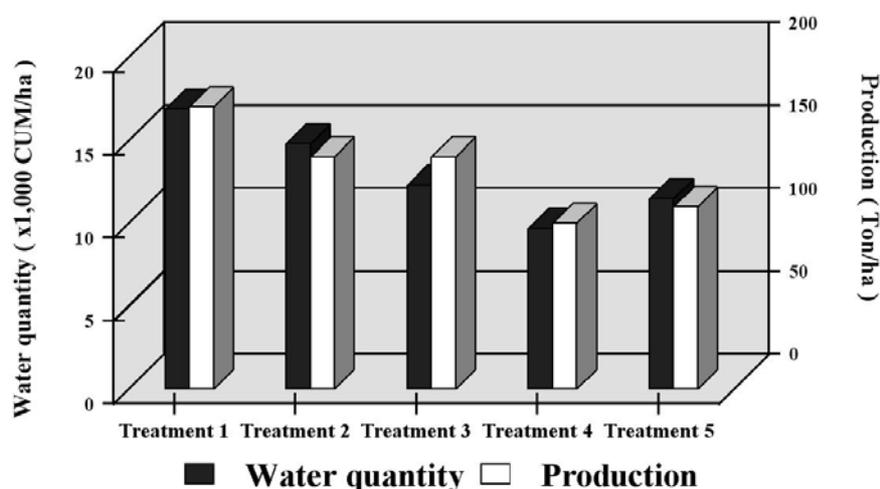


Figure 4. Water quantity received by sugarcane and production

Comments

- As the study emphasized on the overview of the usage of subsurface drip irrigation to replace the surface irrigation and the determination of suitable water quantity to supply for sugarcane to obtain maximum production, so the statistical analysis of the relationship between water quantity and production was not included.
- In application of subsurface drip irrigation in the sugarcane planting plot, it is found that the water quantity received by the plot conforms to the requirement of each treatment. The production is rather high, especially in Treatment 1 which the highest production is 170 tons/ha, with the average water use of 5.35 mm/day and water use efficiency (Ey) 10.31 kgs/m³. It conforms the previous studies on water requirement and suitable water use for sugarcane (Pramote, 1992; Sajee, 1985; 1987; 1991) which indicate that the water supplied by using ET/E = 1.2 resulting in the production of about 130 tons/ha which is higher than other treatments, using water quantity at 5.25 mm/day with water use efficiency of 7.89 kgs/m³.
- From Table 2, the sugarcane production obtained from Treatment 2 and 3 are the same, that is 140 tons/ha although the water quantity received by sugarcane was different. Therefore, it may indicate that in the area of plenty irrigation water, the Treatment 1 can be introduced in order to obtain the maximum production. While, in the area just adequate or limited amount of water, the Treatment 3 should be applied because more water can be saved than Treatment 1 and 2 and it corresponds to the water use efficiency (Ey) of 11.33 kgs/m³.

CONCLUSION AND RECOMMENDATIONS

Conclusion

- It is found that the subsurface drip irrigation can supply water for sugarcane on a timely manner and as required. It also can reduce labor for watering. The growth rate is rather good and the production is satisfactorily high.
- Concerning the sugarcane production, it is indicated that Treatment 1, which received rain water of 453 mm and irrigation water of 1,233 mm, 1,686 mm in total or 5.35 mm/day on average, has the potential to produce the highest yield of 170 tons/ha with water use efficiency (Ey) of 10.31 kgs/m³.
- The sugarcane production obtained from Treatment 1-5 was 170, 140, 140, 100 and 110 tons/ha higher than the standard production of U-Thong 3 variety at 100 tons/ha, by 70%, 40%, 40%, 0% and 10% respectively.

Recommendations

- As the soil texture is clay loam which has the characteristics of low soil compaction and long time of irrigation makes the soil saturated, the tall sugarcanes fall down after the strong wind.
- As the irrigation system is placed under the ground, it is hard to observe any leakage or crack occurring. It is, therefore, necessary to investigate and check frequently.
- In the past, Thailand used to apply the subsurface drip irrigation for sugarcane plantation at Wang Kanai Sugar Factory, Phanom Thuan District, Kanchanaburi Province. Due to the problems of high investment cost, requirement of special equipment for system installation; as well as the dissatisfaction of farmers, because they had enough water at that time; it was not extended. At the present, as necessary equipment is cheaper and technologies for system installation, planting and harvesting have been much developed for convenient provision and operation. By these reasons, it is considerable to apply subsurface drip irrigation for sugarcane planting in order to secure the water saving and expansion of planting areas and increase of production. In addition, this result of study can support the data of water requirement of sugarcane so that the application of available data can be more convenient and bring about the maximum benefit.
- As the Treatment 1 provides the highest yields by using more water than other treatments, thus it is questionable that the increase of water quantity will directly affect the sugarcane production or not. Also, the water supply in Treatments 2 and 3 was different but the production was the same. Therefore, it is recommended to further study so as to confirm the result.

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