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Effect of fertigation on yield and quality of sugarcane

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ABSTRACT

A field experiment was conducted at Regional Agricultural Research Station, Anakapalle to study the effect of surface drip fertigation on cane yield and juice quality of sugarcane during 2010-11 and 2011-12. Solid, liquid and water soluble forms of N and K fertilizers were applied at two levels viz., 100% (112 Kg N/ha and 100Kg K_2O/ha) and 150% of recommended doses. Nitrogen at 100 and 150% recommended doses without potassium were also included for comparison. Thus total eight treatments were tested in randomized block design with three replications. Sugarcane variety '97A85' ('Visakha') was planted in paired rows of 60/120 cm pattern. The results indicated that application of 150% of recommended doses of N and K fertilizers recorded higher number of millable canes, cane yield and sugar yield irrespective of forms of fertilizers during both the years. Among different forms of fertilizers application, 150% recommended doses of solid N and K fertilizers in the form of urea and murate of potash recorded significantly higher mean cane yield of 106.9 t/ha. Juice quality in terms of sucrose % and CCS % was not influenced significantly due to different treatments. Application of only N fertilizer in the form of urea at 100% recommended level produced lowest cane yield of 85.9 t/ha. Therefore, solid nitrogen and potassium fertilizers in the form of urea and murate of potash respectively at higher dose can be used through fertigation in order to achieve higher cane yield in North Coastal Zone of Andhra Pradesh, India.

Key words: Drip fertigation, Forms of fertilizers; Sugarcane yield

In Andhra Pradesh since 1950s, the land area under cane cultivation, production and productivity have increased dramatically. Sugarcane is cultivating in an area of 1.92 lakh ha with a production of 159 lakh tonnes in A.P where as in India it is cultivated on 4.94 million hectares providing an annual sugarcane production of 340 million tonnes (2010-11). However, cane area and production fluctuating widely year after year. The area under sugarcane is not likely to increase further and the increasing demand of sugar has to be achieved from the same area through improved cane productivity (Nair 2009). Natural resources are declining at faster rate than predicted and are approaching a tipping point. India's water demand will nearly double in 2030 from present 740 billion m^3 to 1.3 trillion m^3. The demand of water for agriculture, industry and power generation is competing and increasing with progressive increase in the population and development of human societies. These two factors are inevitable and therefore, satisfying the increasing water needs for various sectors always remains a matter of concern. Hence, efficient water management for improving agriculture productivity is inevitable.

Sugarcane being a long duration crop requires considerable quantity of water to the extent of 1400–1500 mm in the subtropics (Solomon 2012). Its peak water requirement coincides with the crucial deficit period. Providing optimum soil moisture conditions throughout the crop growing period however, is of paramount importance to realize higher yields (Sundara 1998). Drip fertigation, one of the potential technologies offers the great scope to increase cane productivity up to 200-220 t/ha (Senthil Kumar 2009), saves 40-50% irrigation water and enhances nutrient efficiency by 40% (Solomon 2012). Fertigation with conjunctive use of fertilizer nutrients and irrigation water offers the possibility to optimize the water and nutrient distribution over time and space (Nanda 2010). The present study was therefore, conducted to determine the yield response of sugarcane to various forms of fertilizers at different nutrient levels under drip fertigation.

MATERIALS AND METHODS

A field experiment was conducted at Regional Agricultural Research Station, Anakapalle, Andhra Pradesh during 2010-11 and 2011-12. The soil of the experimental field was sandy loam in texture, neutral in pH, normal in EC (0.08 ds/m), low in available nitrogen (220 kg/ha), medium in available phosphorous(30.21 kg/ha) and high in available potassium (247 kg/ha).

The experiment was designed in Randomized Block Design with three replications for evaluating eight treatments. T_1: 100% recommended dose of N (112 kg N/ha) and K (100 kg K_2O/ha) applied in the form of urea and murate of potash (solid fertilizers); T_2: 150% recommended dose N & K fertilizers in the form of solid fertilizers; T_3 :100% recommended dose of N & K fertilizers applied in the form of water soluble fertilizers; T_4: 150% recommended dose of N & K fertilizers applied in the form of water soluble fertilizers); T_5: 100% recommended dose of N & K fertilizers applied in the form of liquid

fertilizers; T_6 : 150% recommended dose of N & K fertilizers applied in the form of liquid fertilizers; T_7:100% recommended dose of N fertilizer applied in the form of urea, and T_8:150% recommended dose of N fertilizer applied in the form of urea. 100 kg phosphorous (P_2O_5) per hectare was applied in the form of SSP as basal manually at the time of planting. Drip main and submains were placed and drip laterals are installed on soil surface at the distance of 180 cm in such a way that each lateral line was placed in between the each pair of sugarcane rows. Fertigation was given through ventury fixed at the source of water. Measured quantities of N & K fertilizers as per the treatments were supplied through ventury separately. Drip was operated daily to replenish 100% evaporation losses taking into account of rainfall (1123.8 mm and 1145.1 mm of rainfall received during the crop growth period of 2010-11 and 2011-12, respectively). Fertigation schedule was started at 30 days after planting (DAP) with at weekly interval and continued up to 180 days after planting. Thus, the N & K fertilizers in different forms at 100% and 150 % recommended doses were applied through drip in 21 equal splits.

Early maturing sugarcane variety '97A 85' ('Visakha') was planted in paired rows (60 cm/120 cm) using three budded setts @ 40,000/ha in the month of February during two seasons. All other agronomic practices like weeding, earthing up, trash twist propping etc., were carried out according to recommendations. Yield attributes like number of millable canes, cane length and cane yield were recorded at the time of harvest. Juice quality parameters viz., sucrose%, CCS% and sugar yield were recorded at harvest following standard procedures (Meade and Chen 1971). Data collected were statistically analyzed and compared.

RESULTS AND DISCUSSION

Results pertaining to the yield, yield attributes and juice quality parameters are presented in Table 1 and discussed here.

Yield attributes

Cane yield is decided by the number of millable canes. Significant variations in number of millable canes were observed due to different treatments. Application of 150% recommended dose of N & K fertilizers in the form of solid fertilizers produced significantly higher number of millable canes over other treatments. However, it was statistically at par with 150% recommended dose of N & K fertilizers applied in the form of liquid fertilizers. Significantly higher number of millable canes at higher doses of N & K fertilizers applied in the form of solid and liquid fertilizers indicated higher conversion efficiency of tillers into millable canes. Variation in number of millable canes with increase in dose of N, P and K fertilizers from 75 to 125 % recommended doses in the form of solid and water soluble forms under drip fertigation was also reported by Raskar and Bhoi (2001).

The length of millable cane was not significantly influenced by different drip fertigation treatments. However, the tallest canes were recorded in 100% recommended dose of N & K fertilizers applied in the form of solid fertilizers.

Cane Yield

Cane yield showed significant differences due to different levels and forms of fertilizers under drip fertigation. Significant increase in cane yield was observed at higher dose of nitrogen and potassium fertilizers. Increase in sugarcane yield with an increase in fertilizer levels was also reported by Rajanna and Patil (2003). Significantly higher cane yield was recorded in 150% recommended dose of N & K fertilizers applied in the form of solid fertilizers but it was at par with the 150% recommended dose of N & K fertilizers applied in liquid and water soluble forms and also with 100% recommended N & K applied in solid form. Highest shoot population (Table 1)

Table 1 Yield attributes, yield and juice quality of sugarcane as influenced by drip fertigation

Treatment	Number of millable canes per ha	Length of millable cane (cm)	Cane yield (t/ha)	Sucrose %	CCS %	Sugar yield (t/ha)
100% recommended dose of N & K fertilizers applied in the form of solid fertilizers (T_1)	83,476	322	98.8	17.85	13.08	13.0
150% recommended dose N & K fertilizers applied in the form of solid fertilizer (T_2)	87,401	321	106.9	18.10	13.23	14.3
100% recommended dose of N & K fertilizers applied in the form of water soluble fertilizers (T_3)	78,903	302	89.5	17.55	12.85	11.7
150% recommended dose of N & K fertilizers applied in the form of water soluble form of fertilizers (T_4)	81,004	313	98.1	17.1	12.65	12.7
100% recommended dose of N & K fertilizers applied in the form of liquid fertilizers (T_5)	80,687	295	96.4	17.3	12.60	12.3
150% recommended dose of N & K fertilizers applied in the form of liquid fertilizers (T_6)	85,206	313	103.9	18.0	12.00	13.8
100% recommended dose of N fertilizer applied in the form of urea (T_7)	76,058	321	85.9	18.2	13.33	11.5
150% recommended dose of N fertilizer applied in the form of urea (T_8)	79,566	315	89.6	18.75	13.20	11.9
SEm $\pm$	433.0	3.58	3.2	6.93	13.63	
C.D.(P=0.05)	2144.0	NS	9.7	NS	NS	

coupled with efficient conversion of tillers into millable canes at harvest might have contributed to higher cane yield. Raskar and Bhoi (2001) reported that application of straight fertilizers as urea and murate of potash were the best alternate source of water soluble fertilizers.

Juice quality parameters

Juice quality parameters such as sucrose %, CCS % and sugar yield were not effected by drip fertgation treatments. Rajanna and Patil (2003) reported that quality parameters such as brix %, pol % and CCS % were not effected by fertigation. Juice quality depends mainly on genetic nature of the variety (Yanam *et al.* 1997).

Sugar yield

Since the sugar yield is dependent on cane yield and CCS % it followed the pattern of cane yield in relation to the treatments. The highest sugar yield was recorded with 150% recommended dose of N & K fertilizers applied in the form of urea and murate of potash.

Application of 150% recommended dose of N & K fertilizers in solid form and 150% recommended dose of N & K fertilizers applied in liquid and water soluble forms through drip fertigation produced more or less similar cane yield. Application of N & K fertilizers in solid form i.e., urea and murate of potash are comparatively economical than using liquid and water soluble fertilizers which are expensive.

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