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Impact of drip fertigation in augmenting production of ratoon sugarcane (S*accharum officinarum* L.)

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ABSTRACT

Field experiment was conducted at Annamalai University Experimental farm, Department of Agronomy to find out the effect of drip fertigation on the production of ratoon sugarcane. The field trial was conducted during January – December 2016 which wasfollowed by residual succeeding trial on the yield of ratoon sugarcane in the same field during January – December 2017.The experiment was laid out in randomized block design with three replications and 10 treatments. The results indicated that application of 75% P and K as basal + 100% N, 25% P and K as fertigation (T_8) significantly enhanced growth components of sugarcane viz., plant height(276.9 cm), number of tillers(16.5), number of leaves per cane(25.2), and dry matter production(182.3 t ha^{-1}) over control. Application of 50% P and K as basal + 100% N, 50% P and K through fertigation (T_9) proved as next best treatment in respect of these growth attributes.Theyield attributes viz.,higher number of millable cane (1.65 lakhs ha^{-1}), cane girth (3.63c.m), internode length (11.26 c.m), and single cane weight(1.72 kg) were recorded maximum under T_8treatment. The ratoon cane yield (202.56 t ha^{-1})and sugar yield (25.36 t ha^{-1}) were significantly higher with T_8 than control (83.01t ha^{-1} and 7.12 t ha^{-1}) respectively.

INTRODUCTION

The sugarcane industry is the second important agro based industry in India after textiles and it plays a vital role in the rural economy through income and employment generation and the cane production has shown rapid progress in India since independence.Though sugarcane cultivation was confined to assured irrigated and fertile areas, in recent years and its cultivation has been extended to marginal and sub-marginal lands wherein water availability limits the growth and yield of sugarcane. The dream of green revolution came true through proper use of water by drip irrigation. Fertigation is a modern technique of application of water-soluble fertilizers through the irrigation systems (Kumar*et. al*., 2016).The aim of the fertigation program is to supply nutrients dissolved in water directly to the root zone and to minimise wastage of water. Sugarcane is more soil nutrient tapping crop which requires efficient management of input resourcesand its root system is shallow and fibrous. Hence, fertigation is recommended to make most efficient and economic usage of limited water resources to increasewater and nutrient use efficiency. Sugarcane is a widely spaced crop hence, enormous amount of water is being lost in land outside root zone. If proper water management practices are available definitely it will increase the availability of water in root zone and increase the yield of sugarcane.Hence, the present investigation was carried out to develop a system based water management practice for ratoon sugarcane using water soluble fertilizers to find out the impact of fertigation in augmenting the yield of ratoon sugarcane.

MATERIALS AND METHODS

The experiment was conducted in the Experimental Farm, Annamalai Varsity, Annamalainagar. The geographical location of Annamalai Nagar is 11º24' N latitude and 79º44' E longitude at an altitude of + 5.79 m above mean sea level. The soil of the experimental field is Udic chromustert (clay). The initial soil was heavy clay with neutral in reaction (pH = 7.5), low soluble salts (EC = 0.33 dSm^{-1}), medium in available N (236 kg ha $^{-1}$), low in available P_2O_5 (21.8 kg ha $^{-1}$) and high in available K_2O (285 kg ha^{-1}). The experiment was laid out in randomized block design with three replications. There were 10 treatments viz.,T_1 - Control (no nutrient supply), T_2–Farmers practice (275:150:150kgs of N, P_2O_5 and K_2O per hectare), T_3 – 50% P and K as basal and 100% N, 50%, P and 50% K as topdressing, T_4 -

100% NPK through fertigation, T_5 - 75% NPK as basal + 25% NPK through fertigation, T_6 - 50% NPK as basal + 50% NPK through fertigation, T_7 - 25% NPK as basal + 75% NPK through fertigation, T_8 - 75% P and K as basal + 100% N, 25% P and K through fertigation, T_9 - 50% P and K as basal + 100% N, 50% P and K through fertigation and T_{10} - 25% P and K as basal + 100% N , 75% P and K through fertigation. Sugarcane variety SI-7was chosen as test crop in plant crop and ratoon investigation. Water soluble fertilizers *viz.* urea, Polyfeed (13% N, 40% P and 13% K), and Multi-K(13% N and 45% K) were used in the respective plots as per the treatment schedule. The recommended package of practices was followed and the crop was harvested. For the estimation of dry matter production, six plants were removed randomly at harvest stage. These samples were first air dried in shade and then oven dried at 80 ± 5°C till a constant weight was obtained and the weight was recorded. The yields of each treatment were recorded separately and analyzed statistically with Analysis of Variance.

RESULTS AND DISCUSSION

Growth components

The growth components of ratoon sugarcane *viz*., plant height, number of tillers, number of leaves per cane, and dry matter production were significantly influenced by the application of 75 % P and K as basal + 100% N, 25% P and K through fertigation (T_8)compared to other treatments (Table 1). This was followed by application of 50% P and K as basal + 100% N, 50% P and K through fertigation (T_9).

Table 1: Effect of fertigation on growthcharacters of ratoon sugarcane

Treatments	Plant height (cm)	Tillers clump^{-1}	Leaves cane^{-1}	LAI	DMP (t ha^{-1})
T_1 – Control (no nutrient supply)	157.1	6.2	8.1	1.79	77.7
Farmer's practice	221.1	10.5	13.1	2.24	91.8
50% P and K as basal and 100% N, 50%, P and 50% K as topdressing	256.3	13.8	20.8	3.50	142.1
T_4 - 100% NPK through fertigation	228.4	11.3	14.7	2.58	108.1
T_5 - 75% NPK as basal + 25% NPK as fertigation	249.3	13.0	19.2	3.24	131.0
T_6 - 50% NPK as basal + 50% NPK as fertigation	242.2	12.1	17.7	2.95	117.1
T_7 - 25% NPK as basal + 75% NPK as fertigation	235.1	11.4	16.1	2.63	108.9
75% P and K as basal + 100% N, 25% P and K as fertigation	276.9	16.5	25.2	4.08	182.3
50% P and K as basal + 100% N, 50% P and K as fertigation	270.1	15.4	23.7	3.91	174.9
- 25% P and K as basal + 100% N, 75% P and K asfertigation	263.2	14.5	22.3	3.72	163.0
S.Em.$^{+}$	3.4	0.35	0.68	0.07	0.48
CD (P=0.05)	6.78	0.70	1.37	0.15	0.96

The least values of growth components were recorded under control (no nutrient supply). The increased number of tillers might be due to continuous supply of nutrients to the crop at needy growth stages, which would have provided enough nutrients for better protoplasmic formation and function which consequently produced more number of tillers.The increased performance of growth charactersof ratoon sugarcane might bedue to fertigation whichmight have improved the chlorophyll formationdue to higher leaf area index resulting in increased accumulation of dry matter production. The results are in line with those of Mahesh and Asoka (2015). Optimum soil moisture and nutrient availability have also been shown to increase the photosynthetic rate in sugarcane (Ramesh and Mahadevaswamy, 2000). The appreciable increments in tiller number and leaf area increased dry matter production under different levels of fertigation which improved the utilization efficiency of fertilizers. The increased number of stalks and dry matteraccumulation through fertigation has been reported by Kumar*et. al (*2016).

Yield attributes

The yield attributes *viz*., highernumber of millable cane, cane length, cane girth, internode length and single cane weightwere favourably influenced by the application of 75 % P and K as

basal + 100% N, 25% P and K through fertigation (T_8) compared to other treatments (Table 2). This was followed by application of 50% P and K as basal + 100% N, 50% P and K through fertigation (T_9). The least values on yield attributes were recorded under control (no nutrient supply).

The increased performance of yield attributes might be due to the response of fertigation through liquid fertilizers which enhanced the availability of nutrients and improved the fertility status of the soil stratum. Drip fertigation, increased the number of efficient tillers, promote the stalk elongation and diameter enlargement, and finally increase the individual cane weightas reported by Manikandan *et.*al.(2019).Fertigation improves the utilization of fertilizer and therefore can boost plant growth, increase the number of effective tillers, promote stalk elongation and diameter enlargement and ultimately increase the millable cane yield. Similar findings were reported by Mahesh and Ashok (2015).

Cane and sugar yield

Application of NPK through fertigation significantly influenced the ratoon cane yield. The highest cane yield of 202.56 tonnes $ha^{-1}$was recorded with 75% P and K as basal + 100% N, 25% P and K through fertigation. The higher yield in ratoon sugarcane might be due to maintenance of good volume of soil water – air and the timely availability of nutrients during the crop period (Gurusamy *et al.*2013)**.**As major portion of P and K are available as basal and 100 % N is available through fertigation throughout the growth period, would have created a congenial fertility status for the crop to get maximum yield. These favourable environments created by liquid fertilizers *viz.,* urea, polyfeed and multi-K would have positively reflected on growth components due to uninterrupted supply of essential nutrients which resulted in higher cane yield as reported by Yadav *et al.* (2012). The increased water use efficiency under subsurface drip fertigation system resulted in efficient utilization of available water and nutrients that were supplied at even intervals throughout the crop period to meet the crop needs that brings in the increased yield (Bangar and Chaudhari 2004).Sharala *et. al*., (2010) also reported similar results.

Sugar yield

Fertigation with 75% P and K as basal + 100% N, 25% P and K through fertigation (T_8) recorded highest sugar yield of 25.36 t ha^{-1}. Higher cane yield coupled with highest Pure Obtainable Cane Sugar (POCS) per cent at different levels of fertigation applied plots might have contributed for the higher sugar yield. The increased level of sugar yield in the best treatment might be due to non-stop, continuous and steady supply of best aeration aligned with water soluble nutrients provided at every stage of the crop. The favourable environments might have played a vital role which ultimately resulted in increased sugar yield (Gurusamy *et al.*2010).

Table 2: Effect of fertigation on yield attributes, cane yield and sugar yield of ratoon sugarcane

Treatments	Millable cane (lakhs ha^{-1})	Cane girth (cm)	Internode length(cm)	Single cane weight (kg)	Cane yield (t ha^{-1})	Sugar Yield (t ha^{-1})
T_1	0.72	2.37	4.66	0.77	83.01	7.12
T_2	1.05	2.53	5.34	0.98	102.00	10.15
T_3	1.38	3.19	9.15	1.40	157.90	18.05
T_4	1.13	2.68	6.19	1.08	120.03	12.40
T_5	1.30	3.04	8.40	1.29	145.61	16.10
T_6	1.21	2.89	7.62	1.19	130.12	13.92
T_7	1.14	2.74	6.81	1.09	121.02	12.50
T_8	1.65	3.63	11.26	1.72	202.56	25.36
T_9	1.54	3.48	10.58	1.61	194.38	23.62
T_{10}	1.45	3.34	9.88	1.50	181.16	21.29
S.Em.$^+$	0.03	0.07	0.32	0.05	4.06	0.18
CD(P=0.05)	0.07	0.14	0.65	0.10	8.12	0.36

Based on the results of the present investigation, it may be concluded that fertigation with 75% P and K as basal + 100% N, 25% P and K through fertigation in sugarcane resulted in enhanced yields in ratoon sugarcane. Adoption of drip fertigation system in sugarcane cultivation is technically feasible and can be vigorously followed.

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