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Evaluation of Planting Materials and Nutrient Levels in Chewing Cane (*Saccharum officinarum*)

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A field experiment was conducted at Agricultural College and Research Institute, Madurai, during 2012-2013 to evaluate the performance of planting materials and nutrient levels in chewing cane. (*Saccharum officinarum*). The experiment was laid out in factorial randomized block design with three replications. The treatments evaluated were planting materials of single budded setts (M_1), double budded setts (M_2), single chip bud seedlings (M_3) under factor I and the nutrient levels *viz.,* application of 100 per cent RDF + vermicompost @ 5 t ha^{-1} (S_1), 75 per cent RDF + vermicompost @ 5 t ha^{-1} (S_2), 50 per cent RDF + vermicompost @ 5 t ha^{-1} (S_3), 100 per cent recommended dose of N, P and 125 per cent K + vermicompost @ 5 t ha^{-1} (S_4), 75 per cent of N, P and 125 per cent K + vermicompost @ 5 t ha^{-1} (S_5) under factor II. The recommended dose of sugarcane is 275:62.5:112.5 kg NPK ha^{-1}. The result revealed that among the planting materials, single chip bud seedlings recorded the highest cane yield. Regarding the nutrient levels, application of 100 per cent recommended dose of N, P and 125 per cent K + vermicompost @ 5 t ha^{-1} recorded the best results. Regarding the interaction, the combination of planting single chip bud seedlings along with application of 100 per cent recommended dose of N, P and 125 per cent K + vermicompost @ 5 t ha^{-1} recorded the highest cane yield. All the growth attributes showed the similar results.

Key words: Chewing cane, Planting materials, Nutrient levels, Chip bud method.

Sugarcane (*Saccharum officinarum* L.) is one of the important commercial crops of the world and its cultivation is spread over tropical and subtropical countries. There are 102 countries in the world growing sugarcane. India stands second in the world after Brazil, in terms of both in area (4.9 million ha) and production (339.2 million tonnes) and the productivity is 68.6 t/ha. About one per cent of the cane produced in India is used for chewing. In Tamil Nadu, sugarcane is cultivated in an area of 3.20 lakh ha. The production is 350 lakh tonnes and the average productivity is 108 t ha^{-1}(Thirumurugan *et al.*, 2011). Chewing canes are in great demand during festival times, both for worship and chewing. It is robust, softer and juicier containing more fibre than the industrial canes (Gana, 1996) . During 'Pongal', the harvest festival of Tamil Nadu, chewing canes are sold at a very high cost. The consumption of chewing canes for 'Pongal' alone in Tamil Nadu is estimated at about 90,000 to 1 lakh tonnes (Rakkiyappan *et al.*, 2003). The fluctuations in cane yield can be minimized through the use of appropriate planting material. Thus, planting material plays an important role in deciding the cane productivity particularly in sub-tropical countries like India, where germination is a serious problem in sugarcane. Sugarcane is a long duration and exhaustive crop resulting in large biomass, it removes considerable amount of nutrients from soil for its normal growth and development. Addition of organic manures and inorganic fertilizer at appropriate time and in optimum quantity is essential for higher productivity (Bokhtiar and Katsutoshi, 2005). Practically very little has been reported on the planting materials and fertilizer levels for chewing cane. Considering all the above facts, the present study in chewing cane was carried out to find out appropriate of planting materials and nutrient levels.

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Materials and Methods

The field experiment was conducted during 2012-2013 at Agricultural College and Research Institute, Madurai. The experimental soil was sandy clay loam in texture having a pH of 7.53. The fertility status was low in available N, P (275.9 and 10.3 kg ha^{-1}, respectively) and medium in available K (256.7 kg ha^{-1}). The organic carbon was 0.30 per cent. The experiment was laid out in factorial randomized block design with three replications. The treatments evaluated were planting materials of single budded setts (M_1), double budded setts (M_2), planting single chip bud seedlings (M_3) under factor I and the nutrient levels, viz., application of 100 per cent RDF + vermicompost @ 5 t ha^{-1} (S_1), 75 per cent RDF + vermicompost @ 5 t ha^{-1} (S_2), 50 per cent RDF + vermicompost @ 5 t ha^{-1} (S_3), application of 100 per cent recommended dose of N, P and 125 per cent K + vermicompost @ 5 t ha^{-1} (S_4), 75 per cent recommended dose of N, P and 125 per cent K + vermicompost @ 5 t ha^{-1} (S_5) under factor II.

The selected healthy setts were soaked in 0.1% carbendazim for 15 minutes to control the primary infection by pathogenic fungi. The single and double budded setts were planted under raised bed with a row spacing of 60 cm. The nursery was taken on the same day for M_3 treatment. From the selected canes, the single chip buds were raised individually in the plastic cups with required quantity of coco -pith (coconut coir waste) and vermicompost. The recommended dose of fertilizers followed was 275:62.5:112.5 kg NPK ha^{-1}. For the treatments S_1, S_2 and S_3 100, 75 and 50 percent of the RDF were, respectively applied. In S_4 100 per cent N, P and 125 per cent K and in S_5, 75 per cent of N, P and 125 per cent K were applied in five equal splits during 30, 60, 90, 120 and 150 DAP as per the treatment. Five tonnes of vermicompost to each treatment as organic source in four equal splits were applied as basal, 30, 60 and 90 DAP.

The establishment counts were taken on 21st day and gap filling was done in few plots to get uniform base population. The growth parameters of tiller production and LAI were recorded at 90 and 210 days after planting respectively. The yield parameters *viz,* cane length, cane girth and quality parameters of brix percentage and juice weight were recorded at maturity stage.

Results and Discussion

Tiller production

Among the planting materials, planting single chip bud seedlings (M_3) recorded higher number of tillers (2,70,690 ha^{-1}) at 90 DAP followed by planting double budded setts (M_2). The tiller number was low in planting single budded setts (M_1). Planting of seedlings helped to maintain the required population of cane in the main field compared to the sett materials and in chip bud method, conversion ratio from tillers to chewing canes was found to be high and the loss was restricted, due to the practices like transplantation of young seedlings with wider spacing. Similar findings were reported by Sathiya *et al*. (2011).

Table 1. Effect of planting materials and nutrient levels on tiller production, LAI, cane length and cane girth of chewing cane

	Tiller production (000 /ha) at 90 DAP				Leaf area index at 210 DAP				Cane length (m)				Cane girth (cm)			
Treatment	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean
S_1	223.4	230.6	278.5	244.2	7.7	8.1	8.9	8.2	1.6	1.8	1.9	1.8	12.7	12.9	13.3	13.0
S_2	206.8	237.0	261.5	235.1	6.7	7.8	8.7	7.7	1.7	1.7	1.9	1.7	11.1	12.7	13.2	12.3
S_3	188.2	207.9	257.1	217.7	6.6	7.7	8.6	7.6	1.5	1.6	1.8	1.6	12.3	11.5	13.0	12.3
S_4	241.6	249.6	281.4	257.6	8.2	8.5	9.1	8.6	1.9	1.9	2.1	2.0	13.7	13.6	13.8	13.7
S_5	228.1	235.5	275.0	246.2	7.0	7.9	8.8	7.9	1.7	1.6	1.9	1.8	12.8	12.2	13.0	12.7
Mean	217.6	232.1	270.7	240.2	7.2	8.0	8.8	8.0	1.7	1.7	1.9	1.8	12.5	12.6	13.3	12.8
	M	**S**	**M x S**		**M**	**S**	**M x S**		**M**	**S**	**M x S**		**M**	**S**	**M x S**	
SEd	2.7	3.4	5.9		0.1	0.1	0.2		0.0	0.0	0.0		0.2	0.3	NS	
CD/(P=0.05)	5.4	7.0	12.2		0.2	0.2	0.4		0.0	0.0	0.1		0.5	0.6	NS	

In the case of levels of nutrient treatments, application of 100 per cent recommended dose of N, P and 125 per cent K + vermicompost @ 5 t ha^{-1} recorded significantly higher number of tillers of 2,57,550 ha^{-1} at 90 DAP and followed by 100 percent RDF + vermicompost @ 5 t ha^{-1}(Table 1). This was mainly due to increase in RDF with split application. Similar findings were reported by Jayaraman and Alagudurai (2003) and Geddawy and Debaby (1996).

The interaction effect of planting materials and nutrient levels significantly influenced the number of tillers. Combination of planting single chip bud seedlings (M_3) with application of 100 per cent recommended dose of N, P and 125 per cent K + vermicompost @ 5 t ha^{-1} (S_4) registered higher number of tillers (2,81,400 ha^{-1}) at 90 DAP. The number of tillers was low in planting single budded setts with application of 50 per cent RDF + vermicompost @ 5 t ha^{-1} (M_1S_3).

Leaf Area Index

Leaf area index is one of the important growth attributes was significantly influenced by planting materials and level of nutrients applied. Planting materials of single chip bud seedlings resulted in higher LAI of 8.8 at 210 DAP. The results of the experiment clearly indicated that planting single chip bud seedlings increased LAI of the chewing cane compared to single and double budded setts (Table 1).

Regarding nutrient levels, application of 100 per cent recommended dose of N, P and 125 per cent K + vermicompost @ 5 t ha^{-1} resulted in higher nutrient uptake and use efficiency and in turn lead to higher leaf area index due to enhanced availability of nutrients by continuous supply of nitrogen, phosphorous and potassium. Similar findings were reported by Navnit kumar and Sinha (2008).

Combined effect of planting materials and nutrient levels was significant. Planting single chip bud seedlings with application of 100 per cent recommended dose of N, P and 125 per cent K +

vermicompost @ 5 t ha^{-1} (M_3S_4) recorded higher LAI of 9.1 at 210 DAP . Lower LAI was observed in planting single budded setts with application of 50 per cent RDF + vermicompost @ 5 t ha^{-1} (M_1S_3) at 210 DAP.

Cane length and girth

The cane length and girth was significantly influenced by planting materials and nutrient levels. Among the planting materials, single chip bud seedlings (M_3) recorded higher cane length of 1.91 m and cane girth of 13.27 cm at harvest.

Regarding nutrient levels, application of 100 per cent recommended dose of N, P and 125 per cent K + vermicompost @ 5 t ha^{-1}(S_4) recorded significantly higher cane length of 1.98 m and cane girth of 13.67 cm at harvest followed by application of 100 per cent RDF + vermicompost @ 5 t ha^{-1} (S_1).

With regard to interaction effect, the higher cane length of 2.10 m was recorded in planting single chip bud seedlings along with application of 100 per cent recommended dose of N, P and 125 per cent K + vermicompost @ 5 t ha^{-1} compared to single and double budded setts with graded level of NPK (Table 1). This was due to higher dose of NPK in five splits and its superiority to increase cane length. Similar findings were earlier reported by Tamil Selvan (2000).

The girth of the cane is one of the yield parameter and this determines the final cane yield. The maximum girth of 13.77 cm was recorded in planting single chip bud seedlings along with application of 100 per cent of recommended dose of N, P and 125 per cent of K + vermicompost @ 5 t ha^{-1}. Similar findings were reported by Mahar (2008). Abbasi (2005) also stated that increased cane girth was relatively associated with optimum NPK fertilizers and organic fertilizer sources.

Brix percentage and juice weight

The juice weight and brix percentage was significantly influenced by planting materials and nutrient levels. Among the planting materials, single chip bud seedlings (M_3) recorded significantly higher juice brix value of 18.50 per cent and higher juice weight of 1.68 kg cane^{-1} at harvesting stage.

Regarding the nutrient levels, higher brix percentage (18.77) and juice weight (1.88 kg cane^{-1}) was observed in application of 100 per cent recommended dose of N, P and 125 per cent K + vermicompost @ 5 t ha^{-1} (S_4).

The planting materials of single chip bud seedlings with application of 100 per cent recommended dose of N, P and 125 per cent K + vermicompost @ 5 t ha^{-1} improved the cane quality characters viz., brix of 19.20 and juice weight of 2.2 kg cane^{-1} (Table 2). The result indicated that application of K played key role in sucrose synthesis it increased brix percentage in juice. Similar findings were reported by Vijay Kumar and Verma (2002) and Singh and Sinha (1989). All these characters responded well to organic fertilizer, while NPK fertilizers proved their superiority in relation to fulfillment of nutrient requirements of the crop. These results are in confirmation with Mahar (2008).

Table 2. Effect of planting materials and nutrient levels on the brix percentage, juice weight and cane yield of chewing cane

	Brix value (%)				Juice weight (kg cane^{-1})				Cane yield (t ha^{-1})			
Treatment	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean	M_1	M_2	M_3	Mean
S_1	18.00	17.90	18.60	18.17	1.39	1.42	1.83	1.55	77.14	92.06	105.46	91.55
S_2	17.90	17.80	18.20	17.97	1.32	1.22	1.45	1.33	70.22	71.58	99.94	80.58
S_3	17.40	17.60	17.80	17.60	1.18	0.78	1.34	1.10	59.04	68.78	95.23	74.35
S_4	18.50	18.60	19.20	18.77	1.82	1.60	2.22	1.88	93.79	96.00	107.81	99.20
S_5	18.20	18.30	18.70	18.40	1.39	1.24	1.55	1.39	72.29	79.78	100.82	84.30
Mean	18.00	18.04	18.50	18.18	1.42	1.25	1.68	1.45	74.49	81.64	101.85	86.00
	M	**S**	**M x S**		**M**	**S**	**M x S**		**M**	**S**	**M x S**	
SEd	0.17	0.22	NS		0.01	0.01	0.03		1.93	2.50	4.33	
CD(0.05)	0.35	0.45	NS		0.02	0.03	0.06		3.96	5.12	8.88	

Higher value of juice weight due to production of homogenous population and uniform maturity resulting in better quality. Similar results were reported by Tamil selvan (2000). Further, one of the main reasons that could be attributed for higher quality characters even under prolonged application of fertilizers upto 150 DAP might be due to the uniform growth of the cane with early internode formation and better assimilation of photosynthesis. The favorable influence was due to the uniform growth of chewing canes with almost uniform maturity of cane at harvest and consequently resulted in higher quality characters. Similar results were also reported by Selvaraj *et al*., (1997).

Cane Yield

The yield data showed the favorable effect of planting materials on cane yield at higher levels of fertilizer application. Planting single chip bud seedlings (M_3) recorded significantly higher cane yield of 101.85 t ha^{-1} which was followed by planting double budded setts (M_2).

Application of 100 per cent recommended dose of N, P and 125 per cent K + vermicompost @ 5 t ha^{-1} (S_4) recorded significantly higher cane yield of 99.20 t ha^{-1} followed by application of 100 per cent RDF + vermicompost @ 5 t ha^{-1} (S_1), application of 75 per cent of N, P and 125 per cent K + vermicompost @ 5 t ha^{-1} (S_5). This might be attributed to the ability of vermicompost in improving the soil structure and aeration thereby reducing leaching of inorganic fertilizer applied consequently leading to the increased in yield. These result are in confirmation with Vijay Kumar and Verma (2002).

Combination of planting single chip bud seedlings along with application of 100 per cent of recommended dose of N, P and 125 per cent K + vermicompost @ 5 t ha^{-1} recorded the highest cane yield of 107.81 t ha^{-1}. It was comparable with planting single chip bud seedlings along with application of 100 per cent RDF + vermicompost @ 5 t ha^{-1} (Table 2). It was due to increased values of growth characters like survival per cent and LAI increasing the photosynthesis, which resulted in significant increase in number of chewing canes, cane length, cane weight, number of internodes which ultimately enhanced the biological efficiency of the cane. These with the increased dose of nitrogen and potassium due to their synergistic effect and balanced availability over a longer duration resulted in higher cane yield. This is in confirmation with the findings of Jeyaraman and Alagudurai (2003).

Hence, it could be concluded that integrated approach of planting single chip bud seedlings with application of 100 per cent recommended dose of N, P and 125 per cent K in five equal splits during 30, 60, 90, 120,150 and four equal splits of vermicompost @ 5 t/ha at basal, 30, 60 and 90 DAP was found to be a better agronomic option to obtain higher yield and economic returns of chewing cane.

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