



Effect of planting material and seed rate in pit planted sugarcane (*Saccharum* spp. hybrid complex) in sub-tropical India

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ABSTRACT

To find out the optimum and economic viable planting material and seed rate in pit method of planting in sugarcane (*Saccharum* spp.), a field experiment was conducted during spring season of 2007-08 and 2008-09 at Karnal. Experiment consisting of fourteen treatments (two budded setts and pre-germinated cane settlings planted in pits @ 12,15,18,21 and 24 or at double their rates in single budded setts) was laid out in randomized block design with 3 replications. Double budded setts and pre-germinated cane settlings produced higher cane and sugar yield when compared with planting of single budded setts. Planting materials of 21 double budded setts, 21 cane settlings and 42 single budded setts /pit being at par produced significantly higher cane yield, sugar yield and returns over their corresponding lower rates of planting materials. Planting of 12 two budded setts or settlings/pit or 24 single budded setts recorded the lowest cane yield, sugar yield, net returns and B: C ratio.

Key words: Economics, Pit planting, Planting material, Seed rate, Sugarcane, Sugar yield, Cane yield

Unsuitable climate and use of sub-optimal agro-technologies are mainly responsible for low sugarcane (*Saccharum* spp. hybrid complex) productivity in sub tropical region of India, where at the harvesting 60 % of canes are comprised of tillers, whereas in tropical parts majority of cane population is formed of main shoots. This may be one of the reasons of higher yield in tropical climate than the sub-tropical climate. Therefore, higher sugarcane yield can be achieved by increasing the number of main shoots instead of tillers. Singh *et al.* (1984) developed a new planting technique i.e. ring system (pit planting method of sugarcane) through which the growth of main shoots is encouraged and that of tillers is suppressed and reported almost double cane yield (184 t/ha) to that obtained in conventional flat planting (94.1 t/ha).

Besides other agronomic constraints, sub-optimal plant density and inappropriate plant distribution limit the cane productivity in sugarcane to a larger extent. Ring pit method of planting of sugarcane is becoming popular due to availability of tractor drawn pit digger, higher cane and sugar yield, higher returns and better ratoon (Mehtar Chand *et al.*, 2010, Maqsood *et al.*, 2005 and Singh *et al.*, 2008 and Yadav, 2004). A lot of variations in cane yield were observed at farmers' field demonstrations in Haryana, conducted by Department of Agriculture on pit

planting, and these variations in yield may be due to sub-optimal mother shoot population and other agronomic constraints. The fluctuations in cane yield can be minimized through the use of appropriate seed quantity and planting material since this method is dependent on mother shoot and these mother shoots are allowed to develop into millable canes. Thus planting material plays an important role in deciding the cane productivity particularly in sub-tropical India, where germination is a serious problem in sugarcane. Double budded setts were reported to give higher cane and sugar yield when compared with single bud under conventional method of planting due to early vigour, higher cane height and cane weight (AICRPS, 2009). The pre-germinated cane settlings can be a good source of planting material to ensure optimum plant population in pit planting particularly in areas where there is problem of poor germination. The seed rate and planting material in this technique still needs to be standardized. Consequently, the present study was done to determine the effect of different planting material i.e. single budded setts, double budded setts and pre-germinated cane settlings with different planting densities on the cane yield and economic aspect in pit planting.

MATERIALS AND METHODS

A field experiment was conducted during spring season of 2007-08 and 2008-09 at Regional Research Station,

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(Karnal) of Chaudhary Charan Singh Haryana Agricultural University (29-°43' N latitude, 76° 58'E longitude with an altitude of 245 m above mean sea level). The climate of the region is hot and humid summer and very cold winter. The temperature falls to the lowest in January and reaches up to 46 °C during May and June. The average maximum temperature ranged between 18.1 °C and 38 °C (2007-08), and from 18.0 °C to 35.9 °C (2008-09), whereas the average minimum temperature ranged from 6.5°C to 26.8 °C (2007-08), and 5.1 °C to 26.2 °C (2008-09). The total rainfall received during crop growth period was 534 mm (30 rainy days), 698 mm (51 rainy days) in 2007-08 and 2008-09, respectively. About 80% of the rains received during July-September during both the years. Usually the monsoon breaks in this area by the last week of June and continues up to second week of September. The experiment was conducted under assured irrigation facilities and need based irrigations were applied to sugarcane. Sugarcane 'CoH 119' was planted during spring season on 27 March, 2007 and 8 March, 2008 on clay loam soil with average pH 8.2 and EC 0.4 dS/m. The soil was low in available nitrogen and medium in available phosphorus and high in potash. Fourteen treatments comprising of planting of 12, 15, 18, 21 and 24 double budded setts/pit, 24, 30, 36 and 42 single budded setts/pit and 12, 15, 18, 21 and 24 seedlings/pit were arranged in randomized block design with three replications. Pits were dug with the help of tractor drawn pit digger with dia of 67.5 cm and depth 45 cm keeping 120 cm centre to centre distance between two pits. Each pit was supplied with 4 kg FYM, 45 g urea and 45 g di-amonium phosphate and well mixed with loose soil before placing planting material. Required number of planting material as per treatments were placed in cyclic manner in each pit followed by spraying of Chlorpyriphos 20% EC @ 5.0 litres/ha in individual pits to control termites and early shoot borer. Pre-germinated cane settlings of 35-day-old were transplanted in pits according to different treatments. First irrigation was applied manually in individual pit and soon after the disappearance of water from the pit, 2.5 cm of dry soil was placed on the setts to conserve the soil moisture and to avoid hard pan. At 60-70 days after planting second dose of nitrogen i.e. 25 g urea/pit was applied and pits were inter-connected to facilitate irrigation after filling of pits with loose soil up to half of the cane height. Third dose of nitrogen was applied in the end of June i.e. 25 g urea/pit along with 4.5 g phorate 10 G/pit and each pit was filled up with loose soil up to ground level. The crop was irrigated at 10 days interval during pre- monsoon and at 20 days interval during post-monsoon period. Propping up was done thrice to avoid lodging of cane. All other inputs were applied as per recommended package of practices of

the region. Observations on number of millable canes, cane length, cane diameter, cane weight and cane yield were recorded using standard procedure at the harvesting. For juice quality analysis at the harvest of the crop, 10 stalks/ plot were collected. The extracted juice was analyzed for brix (soluble solid) by brix hydrometer. After clarifying the juice with lead sub-acetate, the optical rotation of juice was determined by Bosch and Lomb type polarimeter to estimate the sucrose concentration. The sugar yield was calculated by multiplying the CCS % with cane yield. The plant crop was harvested during the month of February, 2008 and March, 2009. The economic parameters were calculated considering the prevailing market rate for different inputs, produce and agricultural operations.

RESULTS AND DISCUSSION

Growth

All the growth parameters were comparatively higher during crop season of 2008-09 when compared with crop season of 2007-08. Such differences in growth parameters could primarily be ascribed to variation in the amount and distribution of rainfall received during the experimental period. Higher (698 mm) and well distributed (51 rainy days) and early planting in 2008-09 when compared with 2007-08 (534 mm, 30 rainy days) is responsible for better growth parameters of sugarcane. The growth parameters of sugarcane varied significantly owing to planting material and seed rates (Table 1). Two budded setts were found superior to single budded setts in germination and growth. Higher values of growth parameters in two budded setts over single budded planting material were due to variation in early vigour. Similar supremacy of double budded setts in growth over single budded setts had been reported from different AICRP centres of sub-tropical and tropical region of the country (Yadav, 1992, and AICRPS, 2009). There was no significant difference in growth parameters between two budded setts and pre-germinated cane settlings.

Productivity

Yield attributing characters and cane and sugar yields were comparatively higher during 2008-09 when compared with 2007-08 owing to better growth parameters. The cane yield increased significantly with increase in planting density up to 21 in two budded setts, 42 in single budded and 24 in pre-germinated cane settlings/pit and no significant increase in cane and sugar yield was observed with their higher number of corresponding planting material, however, all these three treatments were at par with each other. The differences in cane yield between two budded and single budded planting material were mainly due to variation in early vigour, cane height and cane girth and

Table 1. Effect of seed rate/settling density on number of sprouts/pit and growth of sugarcane in pit method of planting.

Treatment (Seed rate/planting density)	Germination(%)		No. of sprouts (35 DAP)		Shoot population in July/pit		Cane height(cm)		Cane girth(cm)	
	2007-08	2008-09	2007-08	2007-08	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
12 two budded setts/pit	47.4	48.9	11.4	12.9	10.3	11.5	245	248	3.36	3.35
15 two budded setts/pit	48.0	49.0	14.4	15.8	13.5	14.6	245	250	3.32	3.34
18 two budded setts/pit	47.6	50.1	17.1	18.5	16.5	17.5	247	250	3.30	3.31
21 two budded setts/pit	47.0	49.9	19.7	20.6	18.3	19.8	248	252	3.30	3.31
24 two budded setts/pit	48.0	50.0	23.0	25.0	22.4	23.5	248	252	3.30	3.30
24 single budded setts/pit	44.3	46.0	10.6	11.9	9.9	10.5	228	231	3.18	3.21
30 single budded setts/pit	45.2	46.6	13.6	15.0	13.0	13.9	230	232	3.16	3.19
36 single budded setts/pit	44.7	44.5	16.1	17.8	15.3	16.2	233	237	3.15	3.16
42 single budded setts/pit	44.4	46.2	18.6	20.5	18.1	19.1	233	237	3.12	3.15
12 settlings/pit			12.0	14.0	11.6	12.9	246	248	3.36	3.37
15 settlings/pit			15.0	16.0	14.5	14.7	247	250	3.36	3.36
18 settlings/pit			18.0	20.0	17.4	19.3	247	251	3.34	3.36
21 settlings/pit			21.0	23.0	20.2	22.0	248	252	3.33	3.34
24 settlings/pit			24	24.0	23.1	23.5	248	252	3.32	3.32
SEm±			0.8	0.7	0.7	0.8	5	5	0.02	0.02
CD (P=0.05)			2.4	2.1	2.0	2.2	14	16	NS	NS

DAP, Days after planting

single cane weight. Similarly two budded setts in terms of cane height, cane girth, individual cane weight and cane and sugar yield over single bud under flat planting were reported superior at different AICRP centres of sub-tropical and tropical region of the country (Yadav, 1992, and AICRPS, 2009). Planting of double budded setts, single budded setts and pre-germinated cane settlings @ 21, 42 and 24/pit being at par recorded significantly higher cane and sugar yield than all other seedling densities. Planting of 12 two budded setts or settlings/pit or 24 single budded setts recorded the lowest cane yield. The variations in cane yield among different planting material and plantings density were due to difference in cane height, girth and number of millable canes at harvest/pit (Yadav and Singh, 1986).

CCS % was not affected significantly by different planting material and seed rate since quality parameters are genetically controlled and are less affected by change in environment. Sugar yield is the resultant of CCS % and cane yield so planting of 21 or 24 two budded setts, 42 single budded setts and 21 cane settlings /pit being at par produced significantly higher sugar yield over their corresponding immediate lower planting material (Table 2). Planting of 12 two budded setts or settlings/pit or 24 single budded setts recorded the lowest sugar yield.

Economics

The data on economic aspect are given in table 3 showed that cost of cultivation was higher in 2008-09 (Table 3) owing to higher seed cane price and labour

charges when compared with 2007-08. Slight differences in cost of cultivation among different planting densities are ascribed to the small variations in cost of seed material with each increment in seed rate and cost on raising pre-germinated cane settlings.

Different treatments showed differential net returns and B: C ratio (Table 3). The values of net returns and B: C ratio was higher in 2008-09 due to better price of sugarcane when compared with 2007-08. Planting of 21, two budded setts or 21 pre-germinated cane settlings were found to give higher net returns and B: C ratio as compared to their lower corresponding immediate planting material. Planting of single budded setts gave lower net returns and B: C ratio among different planting material tested. Similar findings of higher returns with planting of double budded setts than single budded setts were reported from different centres of AICRP programme (AICRPS, 2009). Planting of 12 two budded setts or seedlings/pit or 24 single budded setts recorded the lowest sugar yield. Planting of 42 single budded setts/pit did not prove economical than planting of 21 two budded setts or pre-germinated cane settlings/pit. The differences in net returns and B: C ratios of different treatment combination were primarily due to variations in cane yield and cost of cultivation.

The results of two years study showed that 21 two budded setts/ pit or 21 pre-germinated cane settlings were found most economical and practical seed rate for pit planting when compared with their corresponding lower/higher seed rate. In areas, where there is a problem of poor

Table 2. Effect of seed rate/settling density on yield attributing characters, yield, CCS (%) and sugar yield of sugarcane in pit method of planting

Treatment (Seed rate/ planting density)	NMC (000/ha)		Cane weight (kg)		Cane yield (t/ha)		CCS (%)		Sugar yield (t/ha)	
	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
12 two budded setts/pit	68.1	71.3	1.245	1.250	84.7	85.0	11.8	121.1	10.0	10.3
15 two budded setts/pit	88.7	92.5	1.240	1.248	110.2	113.5	11.7	12.3	12.9	14.0
18 two budded setts/pit	106.9	109.7	1.237	1.240	132.0	135.9	11.7	12.1	15.4	16.4
21 two budded setts/pit	117.9	132.0	1.228	1.231	144.8	146.8	11.6	12.4	16.8	18.2
24 two budded setts/pit	138.0	136.5	1.225	1.228	146.2	149.3	11.7	12.2	17.1	18.2
24 single budded setts/pit	65.3	68.5	1.240	1.242	80.9	83.0	11.6	12.0	9.4	10.0
30 single budded setts/pit	85.5	89.2	1.238	1.240	105.8	109.0	11.5	12.1	12.2	13.2
36 single budded setts/pit	99.1	101.8	1.230	1.235	121.9	124.2	11.6	12.2	14.1	15.2
42 single budded setts/pit	116.6	119.8	1.228	1.232	142.4	144.9	11.5	12.1	16.4	17.5
12 settlings/pit	68.6	69.9	1.250	1.260	86.0	88.9	11.7	12.2	10.1	10.8
15 settlings/pit	89.5	92.0	1.248	1.257	113.1	115.9	11.8	12.3	13.3	14.3
18 settlings/pit	107.2	110.0	1.245	1.255	133.4	135.7	11.6	12.1	15.5	16.4
21 settlings/pit	118.0	129.0	1.243	1.253	141.9	144.0	11.7	12.4	16.6	17.9
24 settlings/pit	138.8	134.0	1.240	1.251	145.0	147.5	11.5	12.3	16.7	18.1
SEm±	2.1	2.3	0.014	0.014	1.6	1.7	0.2	0.2	0.4	0.5
CD (P=0.05)	6.2	6.9	NS	NS	4.7	5.0	NS	NS	1.3	1.4

CCS : Commercial cane sugar

NMC : Number of millable cane

Table 3. Effect of seed rate/settling density on economic parameters of sugarcane in pit method of planting

Treatment	Cost of cultivation (₹/ha)		Net returns (₹/ha)		Net B : C ratio	
	2007-08	2008-09	2007-08	2008-09	2007-08	2008-09
12 two budded setts/pit	87,009	93,396	29,030	58,332	0.33	0.62
15 two budded setts/pit	95,354	1,02,845	55,620	94,645	0.58	0.92
18 two budded setts/pit	1,02,883	1,11,397	77,957	1,25,069	0.76	1.12
21 two budded setts/pit	1,08,434	1,17,304	89,942	1,38,128	0.83	1.18
24 two budded setts/pit	1,11,474	1,20,939	88,820	1,38,843	0.80	1.15
24 single budded setts/pit	86,423	92,680	24,410	51,740	0.28	0.56
30 single budded setts/pit	94,636	1,02,060	50,310	87,600	0.53	0.86
36 single budded setts/pit	1,00,911	1,08,956	66,092	1,07,152	0.65	0.98
42 single budded setts/pit	1,08,156	1,17,117	86,932	1,35,009	0.80	1.15
12 settlings/pit	84,805	89,627	33,015	65,059	0.39	0.73
15 settlings/pit	91,911	97,197	63,036	1,04,469	0.69	1.07
18 settlings/pit	97,498	1,03,451	85,260	1,32,667	0.87	1.28
21 settlings/pit	1,00,488	1,06,550	93,915	1,44,010	0.93	1.35
24 settlings/pit	1,02,284	1,08,715	96,366	1,47,935	0.94	1.36
SEm±			1,041	1,443	0.02	0.02
CD (P=0.05)			3,042	4,214	0.05	0.05

Sugarcane sale price: ₹ 1280/tonne (2007-08), ₹ 1650/tonne (2008-09), sugarcane top: ₹ 500/tonne

germination in pit planting 21 pre-germinated cane settlings/pit can be transplanted to ensure optimum planting density.

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