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Effect of chip-bud method of planting and nitrogen on yield and quality of sugarcane (*Saccharum officinarum*)

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ABSTRACT

A field experiment was conducted during the main season of 1993–94 and 1995–96 at Sugarcane Research Station, Melalathur, to study the effect of chip-bud method of planting and dose and time of nitrogen on early-maturing 'CoC 92061' sugarcane (*Saccharum officinarum* L.). Transplanting of 40 days old chip-bud seedlings grown in polybags could prove superior among different methods of planting chip buds in enhancing cane yield through higher millable cane population and single cane weight. This practice also resulted higher sugar yield owing to substantial improvement in commercial cane sugar (%). The results were comparable with conventional method. The conventional method gave the highest yield and turned out to be the most economical. Application of 281 kg N/ha in 4 splits improved millable canes, single cane weight, cane and sugar yield.

Key words : Sugarcane, Seedlings, Chip bud, Planting method, Nitrogen

In sugarcane, Babbi Reddy *et al.* (1986) reported higher productivity of bud-chip seedlings owing to enhanced tillering. However, the cane yield was not equal to that obtained in conventional sett planting because of the low initial vigour due to transplanting shock. Recently developed poly bag method of planting provided a solution for faster multiplication by higher tillering and more yield with high quality (Williams, 1993). Hence the present investigation was undertaken to find out the yield and quality response of sugarcane grown by using different chip-bud planting methods under varying nitrogen levels.

MATERIALS AND METHODS

A field experiment was conducted with 28 treatment combinations in split-plot design during the main season of 1993–94 and 1995–96 at Sugarcane Research Station, Melalathur. The soil was well drained, sandy clay loam in texture with pH 7.5 and EC 0.2 dS/m, low in available N (212 kg/ha), medium in available P_2O_5 (15.1 kg/ha) and high in available K_2O (268 kg/ha). Seven planting methods consisting of planting of chip-bud seedlings grown in

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raised bed and polybags at 2 different ages, viz. 20 and 40 days, direct planting chip buds with and without NAA treatment and planting 2 budded setts as conventional method were superimposed with nitrogen application. The effect of 2 levels of nitrogen (225 kg/ha and 281 kg/ha) and 2 times of application (3 splits on 0, 45 and 90 DAP and 4 splits on 0,30,60 and 90 DAP) was studied. An early-maturing variety 'CoC 92061' was used for this study. Seedling planting was done by adopting 50,000 seedlings/ha raised from chip bud 80 cm between rows and 25 cm between seedlings. For direct planting, a total quantity of 100,000 chip buds/ha was used. Conventional method was done with 75,000 two-budded setts/ha in 80 cm spacing between the rows. In the main field, 10 cm deep pits were made at an interval of 25 cm in the centre of the furrows and the seedlings of different ages as per the treatment schedule were planted in the pits. At the same time, direct planting of chip buds and two-budded setts were done according to the treatment shedule.

RESULTS AND DISCUSSION

Establishment and tiller production

Adequate and early germination provides a sound basis for higher cane yield. The different chip-bud methods of planting and nitrogen showed considerable variation in germination and establishment (Table 1). Highest establishment of more than 95% was recorded in transplanting of 40 days old chip bud seedlings grown in polybags which could provide conducive base for high tillering and optimum stalk population. This confirms the findings of Williams (1993). Among N levels, 281 kg N/ha applied in 3 splits increased the establishment which could be realized that nutrient environment of soil during initial stage provide better establishment and further tillering in transplanted crop.

Tillering with earliness and intensity is an important contributing factor for final yield of crop in terms of stalk weight and sugar (Yadav, 1991). The differential influence of planting methods on tiller production could be recognized even at 60 days after planting (DAP) (Table 1). Transplanting of 40 days old chip bud seedlings grown in poly bags (P_4) significantly increased tiller production at 60 DAP than conventional method (P_7) and production of early tillers was enhanced to 62% of total tillers. Advantages of this factor could be realized for the production of well-developed quality stalks with rich in juice content. Similar findings were also reported by Babbi Reddy *et al.* (1986) and Yadav (1991). Transplanting of young and raised-bed seedlings and direct planting of chip buds considerably reduced the tiller production due to transplanting shock and poor initial vigour and root development in sugarcane.

In early tillering stage at 60 DAP, higher tiller population was recorded with 281 kg N/ha in 3 splits, viz. 0,45 and 90 DAP perhaps due to the availability of 66% of the above nutrient within 60 DAP. It is appropriate to indicate that split application of higher dose of N paved the way for progressive build up of N availability in the soil. This is in accordance with the findings

Table 1. Effect of chip-bud planting and nitrogen on germination, tiller production and yield components of sugarcane (pooled data of 1993–94 and 1995–96)

Treatment	Establishment* (%)	Tillers ('000/ha)		Cane length (cm)	Cane diameter (cm)	Internodes/ cane
		60 DAP	90 DAP			
Planting method						
P_1, RB 20 days seedlings	77.86	78.24	170.61	202.51	2.65	17.0
P_2, RB 40 days seedlings	87.09	105.35	197.49	209.98	2.91	20.9
P_3, PB 20 days seedlings	87.42	96.25	183.80	207.64	2.84	17.7
P_4, PB 40 days seedlings	97.19	131.25	211.64	215.11	3.06	22.6
P_5, Direct planting + NAA	46.35*	62.90	125.25	169.87	2.58	14.7
P_6, Direct planting	44.66*	63.78	122.69	167.99	2.49	14.5
P_7, Conventional planting	69.49*	124.11	218.13	217.83	3.04	22.2
CD (P = 0.05)	7.04	13.30	13.76	3.04	0.09	1.3
Nitrogen						
N_1, 225 kg/ha in 3 splits	71.27	90.05	166.30	195.72	2.70	17.6
N_2, 225 kg/ha in 4 splits	72.84	93.10	171.80	197.55	2.76	18.2
N_3, 281 kg/ha in 3 splits	73.30	95.64	181.63	200.21	2.84	18.9
N_4, 281 kg/ha in 4 splits	74.05	99.42	184.89	201.34	2.88	19.4
CD (P = 0.05)	1.17	2.02	3.13	0.55	0.02	0.2

RB, Chip-bud seedlings grown in raised bed; PB, chip-bud seedlings grown in polybags; *germination (%); DAP, days after planting/transplanting

of Yadav (1991).

Yield components

Longer millable canes were harvested with conventional method of planting as a result of highest shoot population that tended to increase the rate of leaf emergence. Transplanting of 40 days old chip-bud seedlings grown in polybags produced uniformly early tillers and recorded cane of more length. Higher dose of N applied in 4 splits showed its superiority to recommended dose in increasing cane length. This confirms the findings of Yadav and Prasad (1986). The highest number of 22.6 internodes was recorded by transplanting of 40 days old chip bud seedlings grown in polybags and rated the best among the planting methods. Higher dose of 281 kg N/ha applied in 4 splits significantly enhanced the internode number by recording the highest value of 19.4 internodes (Table 1).

Transplanting of 40 days old chip bud seedlings grown in polybags registered the highest girth of 3.06 cm, followed by 3.04 cm in the conventional method of planting (Table 1). Other planting method also accounted for relatively higher cane girth than direct planting of chip buds. Higher dose of N and more split application resulted in marked improvement in girth.

Planting methods and N application significantly affected the millable cane population at harvest. Among different planting methods, the highest number of millable canes/ha was observed under conventional method (P_7) and however, transplanting of 40 days old chip bud seedlings grown in polybags could bring about similar effect with above-said method as evident by the production of 115,950 canes/ha (Table 2). The results confirm the findings of Babbi Reddy *et al.* (1986). Application of N with higher dose and more number of splits could brought about marked advantage in increasing the number of millable canes. This could be achieved by higher tiller production and better utilization of N.

Transplanting 40 days old chip bud seedling grown in polybags (P_4) showed 10 and 50% increase in single cane weight over conventional method and direct planting chip buds respectively (Table 2). This effect might be due to early formation of tillers in polybag method of planting which facilitated lesser competition between plants due to uniform spacing for individual plants and accumulation of sugar for enhanced weight. Higher individual cane weight in spaced planting was reported by Ramesh (1997). Nitrogen had improved the single cane weight significantly.

Cane yield

Planting of 2-budded setts @ 150,000 buds/ha could provide solution for higher cane productivity perhaps owing to 3 reasons, viz. optimum germination, adequate tillering and optimum weight of individual cane. Among different chip-bud methods of planting, transplanting 40 days old chip bud seedlings grown in polybags brought about phenomenal improvement by recording the highest cane yield of 107.75 tonnes/ha and the yield was increased up to 98% over direct planting chips (Table 2). This particular effect was perhaps due to

Table 2. Effect of chip-bud planting and nitrogen on millable canes, single cane weight and cane yield of sugarcane

Treatment	Millable canes			Single cane weight			Cane yield (tonnes/ha)		
	1993–94	1995–96	Pooled	1993–94	1995–96	Pooled	1993–94	1995–96	Pooled
Planting method									
P_1, RB 20 days seedlings	83.75	91.25	87.49	0.947	1.052	0.999	82.72	85.47	84.09
P_2, RB 40 days seedlings	97.57	109.43	103.49	1.159	1.172	1.215	87.94	95.05	91.49
P_3, PB 20 days seedlings	93.84	97.91	95.87	1.072	1.136	1.104	86.35	90.67	88.51
P_4, PB 40 days seedlings	107.65	124.27	115.95	1.208	1.187	1.345	103.99	111.52	107.75
P_5, Direct Planting + NAA	58.83	67.09	62.96	0.920	0.916	0.918	53.10	73.00	63.38
P_6, Direct planting	51.06	65.49	58.48	0.093	0.900	0.896	45.05	63.99	54.52
P_7, Conventional planting	110.42	126.45	118.43	1.248	1.321	1.221	120.39	121.48	120.93
CD (P = 0.05)	10.75	10.55	6.98	0.089	0.160	0.083	5.43	7.10	6.09
Nitrogen									
N_1, 225 kg/ha in 3 splits	80.14	93.84	86.99	1.027	1.003	1.041	77.15	86.09	81.81
N_2, 225 kg/ha in 4 splits	83.56	96.18	89.98	1.056	1.058	1.078	80.15	88.91	84.53
N_3, 281 kg/ha in 3 splits	89.50	99.30	94.39	1.077	1.123	1.128	85.86	94.69	90.27
N_4, 281 kg/ha in 4 splits	91.44	100.33	95.88	1.099	1.148	1.151	88.01	96.69	92.35
CD (P = 0.05)	2.10	1.13	1.25	0.021	0.030	0.020	1.65	1.53	0.99

RB, Chip-bud seedlings grown in raised bed; PB, chip-bud seedlings grown in polybags

the increased establishment, higher tillering capacity and the production of optimum number of millable canes at harvest. However, reduction in cane yield in this method was 12% as compared to conventional method because of comparatively lower final cane population. This corroborates the findings of Babbi Reddy *et al.* (1986). Higher dose of N coupled with more splits had favourable effect on cane yield perhaps by paving way for the production of optimum number of tillers. Such an effect was reported by Jagtap *et al.* (1992).

Juice extraction

Substantial improvement in juice extraction was observed owing to difference in planting methods (Table 3). Transplanting of 40 days old chip bud seedlings grown in polybags registered higher value of 50.3% perhaps due to production of homogenous population and uniform maturity resulting better quality. Sundara (1993) reported increasing trend of juice extraction due to planting meristem culture seedlings. Considerable reduction in juice extraction was noticed due to higher dose of nitrogen and more splits.

Juice quality

Planting methods and nitrogen had a favourable influence on juice brix (Table 3). Higher values of brix was recorded in transplanting of 40 days old chip bud seedlings grown in polybags (P_4) than in direct planting of chip buds and conventional method. Considerable reduction in juice brix was pronounced with the application of 281 kg of N/ha in 4 splits.

Significant improvement in commercial cane sugar (CCS) could be visualized by transplanting of 40 days old chip bud seedlings grown in polybags over conventional method (Table 3). Increase of juice quality in above treatment was perhaps owing to homogenous maturity of quality parameters. Moreover, spent period of seedlings had added advantage for early maturity. This is in accordance with the findings of Ramesh (1997). Though higher dose of 281 kg N/ha could prove advantageous in increasing yield and yield components, it was associated with lower quality (Table 3). This fact has been extensively explored and well documented by Jagtap *et al.* (1992).

Sugar yield

Transplanting 40 days old chip bud seedlings grown in polybags rated the best by recording 2.5 times more sugar yield than direct planting chips and remained on a par with conventional method. This is in confirmity with findings of Babbi Reddy *et al.* (1986). Higher dose of 281 kg N/ha applied in 4 splits recorded the highest sugar yield over the recommended level (Table 3).

Economics

Though there was 80% saving in the cost of seed material by transplanting chip bud seedlings, the economics was not favourable towards this treatment, as the yield reduction was 13 tonnes/ha (Table 3). However, transplanting chip-bud seedlings grown in polybags registered the highest benefit : cost ratio of 2.26. Most benefit

Table 3. Effect of chip-bud planting and nitrogen on quality parameters of sugarcane (pooled data of 1993–94 and 1995–96)

Treatment	Juice brix (%)	Juice extraction (%)	Commercial cane sugar (%)	Commercial cane sugar (tonnes/ha)	Cost of treatments (Rs/ha)	Net returns (Rs/ha)	Benefit : cost ratio
Planting method							
P_1, RB 20 days seedlings	21.60	41.30	14.36	12.13	27,612	29,568	2.07
P_2, RB 40 days seedlings	22.56	46.18	14.99	13.72	28,491	33,723	2.19
P_3, PB 20 days seedlings	21.55	42.74	14.39	12.75	30,193	29,998	1.99
P_4, PB 40 days seedlings	22.72	50.30	15.53	17.14	32,419	40,856	2.26
P_5, Direct planting + NAA	20.58	40.96	12.78	8.14	26,750	16,126	1.61
P_6, Direct planting	20.49	40.72	12.30	6.69	25,198	11,878	1.48
P_7, Conventional planting	21.48	42.35	14.60	17.71	37,473	44,763	2.20
CD (P = 0.05)	0.81	0.54	0.54	0.99	NA	NA	NA
Nitrogen							
N_1, 225 kg/ha in 3 splits	21.65	43.94	14.41	12.08	28,299	26,917	1.92
N_2, 225 kg/ha in 4 splits	21.67	43.66	14.15	12.29	28,869	28,493	1.94
N_3, 281 kg/ha in 3 splits	21.51	43.34	14.12	13.05	30,022	31,261	2.01
N_4, 281 kg/ha in 4 splits	21.53	43.08	13.86	13.04	30,831	31,970	2.02
CD (P = 0.05)	NS	0.09	0.18	0.25	NA	NA	NA

RB, Chip-bud seedlings grown in raised bed; PB, chip-bud seedlings grown in polybags; NA, not analysed

nature of the above treatment could be attributed to lesser cost of seed material and enhanced yield.

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