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EFFECT OF GROWTH REGULATORS ON IMPROVED SEEDLING VIGOUR INDEX OF SUGARCANE BUD CHIPS COLLECTED FROM DIFFERENT PORTIONS OF THE CANE

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ABSTRACT

2003T121 is a promising pre released cultivar of sugarcane with a problem of sprouting when planted as bud chips as well as 3 budded setts. Bud chips from different portions of the cane (top, middle, bottom) were collected and subjected to pre plant soaking with different growth promoting chemicals *viz*., hydropriming for 24hours, GA_3@ 100ppm for one hour and BAP@50ppm for one hour. The experiment was conducted in split plot design with four main treatments and three sub treatments. Each treatment was replicated thrice. Bud chips collected from the top and middle portion of the cane treated with BAP @50ppm recorded significantly higher percentage of bud sprouting (48.53,39.45), seedling vigour index (469.04,284.15), shoot length (cm) (11.28,7.87) and also the activity of acid invertase enzyme (ìg invert sugars mg^{-1} protein) (70.37,76.40). Bud chips collected from the top one third portion of the cane treated with BAP proved to be effective in improving the seedling vigour index.

KEYWORDS: Sugarcane bud chips, germination percentage, seedling vigour index, acid invertase.

INTRODUCTION

Sugarcane is an important commercial cash crop next to cotton grown between 30° N and 30° S. About 75 per cent of the world sugar (sucrose) is produced from sugarcane and the other 25 per cent comes from sugar beet.

Sugarcane is commercially planted using stalk cuttings or setts. In conventional system prevailing in India, about 6-8 tonnes of seed cane per hectare (nearly 10 per cent of produce) is used as planting material. This method of cultivation is gradually becoming uneconomical, as it accounts for over 20 per cent of the total cost of production besides posing a great problem in transport, handling and storage of seed cane which undergoes rapid deterioration and thereby decreasing the viability of buds.

A viable alternative to this method would be the plant excised auxillary buds of cane stalk called bud chips, which are less bulky, more economical and more easily transportable as seed material. Through bud chip method bud chip raised seedlings shall be transplanted instead of the normal sett planting. This component itself has evolved over a period of around 60 years. The noted Sugarcane Physiologist, Van Dillewijn (1952) was first to suggest that a small volume of tissue and a single root primordium adhering to the bud are enough to ensure germination in sugarcane. However, this technology has not been scaled up at commercial level due to poor survival of bud chips under field conditions. Bud chips consist of lower food reserves (1.2 -1.8g sugar) per bud compared to conventional three budded sett material (6-8 g sugar per bud). The food reserves and moisture content in bud chips depletes faster compared to 2-3 bud setts which reflects in their poor sprouting and early growth.

2003T121 is a popular pre release cultivar of sugarcane for southern agroclimatic zone of Andhra Pradesh with higher yield potential, non flowering habit and good quality jaggery. But it has a specific problem related to field emergence both as setts and bud chips. Germination percentage in this cultivar is very poor (as low as 40 per cent) with a prolonged spread of germination period.

Thus, the present study was conducted to find out the effect of various growth promoting substances on improved sprouting and seedling vigour index of sugarcane bud chips collected from different parts of 2003T121 cane *viz*., top, middle and bottom.

MATERIAL AND METHODS

The experiment was conducted at department of crop physiology S.V Agricultural college, ANGRAU, Tirupati, situated in the southern agro-climatic zone of Andhra

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Pradesh. A promising pre released cultivar of sugarcane, 2003T121was selected for this experiment. Experiment was laid out in split plot design. Bud chips collected from different portions of the cane were considered as main treatments and chemical treatments with growth promoting substances as sub treatments.

The treatments imposed in the experiment were shown below.

M_1T_1. Bud chips of top portion of the cane-untreated

M_1T_2. Bud chips of top portion of the cane- soaked in water for 24 hours.

M_1T_3. Bud chips of top portion of the cane-soaked in GA_3 @ 100ppm for 1 hour.

M_1T_4. Bud chips of top portion of the cane- soaked in BAP @ 50 ppm for 1 hour.

M_2T_1. Bud chips of middle portion of the cane-untreated

M_2T_2. Bud chips of middle portion of the cane-soaked in water for 24 hours.

M_2T_3. Bud chips of middle portion of the cane-soaked in GA_3 @ 100ppm for 1 hour.

M_2T_4. Bud chips of middle portion of the cane-soaked in BAP @ 50 ppm for 1 hour.

M_3T_1. Bud chips of bottom portion of the cane-untreated

M_3T_2. Bud chips of bottom portion of the cane-soaked in water for 24 hours.

M_3T_3. Bud chips of bottom portion of the cane-soaked in GA_3 @ 100ppm for 1 hour.

M_3T_4. Bud chips of bottom portion of the cane-soaked in BAP @ 50 ppm for 1 hour.

The experiment was conducted in 36 protrays. Each protray was considered as one replication for each treatment. Each well of the protray was filled with moist coco peat. The canes were collected from a healthy seven months old crop. Bud chips were collected from different portions of these canes using bud chipper machine. Each of the bud chip weighing nine grams was placed in the wells of protray and covered with coco peat.

Observations on germination (bud sprouting) percentage, shoot length (cm) seedling vigour index and acid invertase activity (ìg invert sugars mg^{-1} protein) was recorded with 15 days interval.

Germination percentage

Germination percentage was calculated as follows.

Germination per cent =

$$\frac{\text{Number of bud chips germinated}}{\text{Total number of bud chips kept for germination}} \times 100$$

Shoot length

Shoot length was measured from the base of the plant to tip of the leaf and is expressed in centimetres.

Seedling vigour index

Seedling vigour index was calculated by using the following formula suggested by Abdul-baki and Anderson (1973).

Vigour index = (shoot length + root length) × germination percentage.

Acid invertase (ìg invert sugars mg^{-1} protein):

The activity of invertase was assayed according to the method of Malik and Singh (1980). The reducing sugar formed by the action of invertase was measured by dinitro salicylic acid reagent (Sumner, 1935).

0.3g of the bud tissue and 5ml of chilled tris-maleate buffer (pH 7.0) were homogenized in a blender, strained through two layers of cheese cloth and centrifuged at 17000 rpm for 30 min at 4°C in a refrigerated centrifuge. This supernatant was then used as a source of invertase.

0.4 ml of enzyme extract, 0.4 ml of 0.2M acetate buffer (pH 4.8), 0.2 ml of 0.2 M sucrose and were added in a test tube to give a total volume of 1 ml. In the control test tubes only the sucrose solution was added after the enzyme was inactivated by boiling for about 5 min. The test tubes were incubated at 30°C for 30 min. Then the test tubes were boiled for 10 min and diluted to 5 ml for the degradation of enzyme. Optical density was recorded with spectrophotometer (Model: Genesys 10S UV-VIS) at 560 nm to know the quantity of invert sugars(glucose and fructose).

Table 1. Effect of different growth promoting chemicals on germination percentage of bud chip seedlings

S. No.	Treatment	15 DAP				30 DAP			
		M1	M2	M3	MEAN	M1	M2	M3	MEAN
1.	T_1 untreated	12.23	12.46	9.32	11.34	22.30	28.13	11.89	20.77
2.	T_2 (water soaking)	18.17	14.04	11.25	14.49	31.17	25.71	19.72	25.53
3.	T_3 (GA_3 @100ppm)	19.37	18.76	13.35	17.16	46.10	40.42	30.49	39.00
4.	T_4 (BAP @50 ppm)	23.87	25.71	16.04	21.87	48.53	39.45	29.51	39.16
	Mean	**18.41**	**17.74**	**12.49**		**37.03**	**33.43**	**22.90**	
		M	**S**	**M × S**		**M**	**S**	**M × S**	
	C.D (P= 0.05)	2.12	1.92	3.33		NS	**8.57**	**NS**	
	S.Em.±	0.54	0.62	1.15		3.14	2.88	4.99	

Table 2. Effect of different growth promoting chemicals on shoot length of bud chip seedlings

S. No.	Treatment	15 DAP				30 DAP			
		M1	M2	M3	MEAN	M1	M2	M3	MEAN
1.	T_1 untreated	67.04	58.32	41.98	55.78	103.91	84.25	49.11	79.09
2.	T_2 (water soaking)	92.96	103.39	76.01	90.79	123.36	97.73	78.38	99.82
3.	T_3 (GA_3 @100ppm)	107.54	99.84	96.50	101.29	292.72	163.01	105.10	186.94
4.	T_4 (BAP @50 ppm)	123.38	146.49	104.61	124.83	469.04	284.15	113.53	288.91
	MEAN	**97.73**	**102.01**	**79.78**		**247.26**	**157.28**	**86.53**	
		M	**S**	**M × S**		**M**	**S**	**M × S**	
	C.D (P= 0.05)	13.43	15.63	NS		32.43	22.65	39.23	
	S.Em.±	3.42	5.26	9.11		8.26	7.62	13.20	

RESULTS AND DISCUSSION

Germination percentage

Germination percentage is more important in vegetatively propagated crops such as sugarcane. Incomplete germination brings wide gaps in the field with resultant low density of crop stand and yield (Subba Rao *et al*., 1959).

Data on effect of different chemical treatments on survival percentage of bud chips was presented in Table.1.

Germination of bud chips were positively correlated with moisture and glucose content of bud tissue (Babu, 1979). Different chemical treatments showed significant difference in survival percentage. Among all treatments T_4 (BAP @50 ppm for 1 hour) recorded highest germination percentage (39.16,) followed by T_3 (GA_3 @100ppm for 1 hour) (39.00)

There was a significant difference in germination percentage of bud chips with respect to the portion of the cane from which they were collected. Bud chips collected from the top portion of the cane showed highest germination percentage (37.03).

Table 3. Effect of different growth promoting chemicals on seedling vigour index of bud chip seedlings

S. No.	Treatment	15 DAP				30 DAP			
		M1	**M2**	**M3**	**MEAN**	**M1**	**M2**	**M3**	**MEAN**
1.	T_1 untreated	4.87	1.91	1.55	2.78	4.87	1.91	1.55	2.78
2.	T_2 (water soaking)	3.87	1.77	1.31	2.31	3.87	1.77	1.64	2.43
3.	T_3 (GA_3 @100ppm)	5.38	2.39	1.80	3.19	7.38	4.39	2.47	4.74
4.	T_4 (BAP @50 ppm)	8.55	5.37	1.44	5.12	11.22	7.87	4.14	7.74
	MEAN	**5.67**	**2.86**	**1.53**		**6.83**	**3.98**	**2.45**	
		M	**S**	**M × S**		**M**	**S**	**M × S**	
	C.D (P= 0.05)	0.47	0.36	0.63		0.64	0.52	0.89	
	S.Em.±	0.12	0.12	0.21		0.16	0.17	0.30	

Table 4. Effect of different growth promoting chemicals on acid invertase of bud chip seedlings

S. No.	Treatment	15 DAP				30 DAP			
		M1	**M2**	**M3**	**MEAN**	**M1**	**M2**	**M3**	**MEAN**
1.	T_1 untreated	34.97	32.83	30.00	32.60	30.57	24.17	20.00	24.91
2.	T_2 (water soaking)	35.70	36.40	32.90	35.00	32.67	26.50	22.90	27.36
3.	T_3 (GA_3 @100ppm)	69.33	51.00	46.80	55.71	56.37	42.30	33.47	44.04
4.	T_4 (BAP @50 ppm)	86.67	84.73	75.63	82.34	70.37	76.40	65.93	70.90
	MEAN	**56.67**	**51.24**	**46.33**		**47.49**	**42.34**	**35.58**	
		M	**S**	**M × S**		**M**	**S**	**M × S**	
	C.D (P= 0.05)	4.01	5.13	8.89		5.33	6.97	NS	
	S.Em.±	1.02	1.73	2.99		1.36	2.35	5.06	

Similar results were corroborated with Singh *et al.* (2016). They observed that, in Sugarbeet, BAP (50ìM) showed highest germination percentage among the treatments. Among different portions of the cane, bud chips collected from the top and middle portion of the cane showed highest germination percentage (37.03 and 33.43) because percentage of reducing sugars was more in this portion compared to that of bottom portion of the cane. This might be due to more availability of reducing sugars which were essential for germination and further establishment of the crop.

Shoot length (cm)

Data on effect of different chemical treatments on survival percentage of bud chips was presented in Table 2.

Different treatments showed significant difference in the shoot length of the seedlings raised from bud chips. Among the treatments T_4 (BAP @50 ppm for 1 hr) (7.74) followed by T_3 (GA_3 @100ppm for 1 hr) (4.74) recorded higher shoot length. Bud chips collected from different portion of the cane also showed significant difference with respect to shoot length. M_1 (bud chips of top portion of

the cane) showed highest shoot length (6.83) compared to the other two. Interaction of M_1T_4 showed significantly highest shoot length (11.22) followed by M_2T_4 (7.87). M_3T_1 recorded least shoot length (1.55). Jain *et al.* (2011) revealed that BAP (50ìM) treated sugarcane bud chip raised seedlings also recorded higher shoot length as they promote cell division, growth, differentiation of cells and synthesis of sucrose in growing meristem of sugarcane. This might be related to the biological function of the kinetin to induce the cell division and cell enlargement.

Seedling vigour index

Data on effect of different chemical treatments on seedling vigour index was presented in table 3.

Significant difference was observed among the treatments with respect to seedling vigour index. Among the mean values of seedling vigour index T_4 (BAP @50 ppm for 1 hour) recorded significantly highest seedling vigour index (288.91) followed by T_3 (GA_3 @100ppm for 1 hour) (186.94). Bud chips collected from the top portion of the cane showed significantly highest seedling vigour index (247.26) compared to that of bud chips collected from other portions of the cane. Interaction of M_1T_4 (bud chips collected from the top portion of the cane treated with BAP @50 ppm for 1 hour) recorded highest seed ling vigor index (469.04) followed by M_2T_4 (bud chips collected from the middle portion of the cane treated with BAP @50 ppm for 1 hour) (284.15).

Similar results were corroborated with Singh *et al.* (2016). They revealed that bud chips collected from top portion of the cane showed better results with respect to seed ling vigour index compared to bud chips collected from the bottom portion of the cane. According to them, it was due to the conversion of reducing sugars in to non reducing sugars in the bottom portion of the cane.

Acid invertase

Acid invertase is essential for germination of buds in sugarcane. It converts non reducing sugars in to reducing sugars. Results pertaining to this were depicted table. 4.

All the treatments differed significantly with respect to acid invertase activity. Among the treatments T_4 (BAP @50 ppm for 1 hour) recorded highest invertase activity (70.90ìg invert sugars mg^{-1} protein) compared to untreated bud chips (24.91ìg invert sugars mg^{-1} protein). Significant difference was observed in activity of acid invertase enzyme with different potions of the cane. Top portion of the cane recorded significantly highest enzyme activity (47.49 ìg invert sugars mg^{-1} protein). Very less enzyme activity was observed in the bud chips collected from bottom portion of the cane (35.58ìg invert sugars mg^{-1} protein). The low enzyme activity in the bottom portion of the cane might be the reason for less conversion and more accumulation of non reducing sugars.

In general, acid invertase activity was observed to be more at 15 days after planting compared to that of 30 days after planting in all the treatments.

CONCLUSION

Morpho-physiological and growth attributes were affected by different chemical treatments. Different growth attributes *viz*., germination percentage, shoot length and seedling vigour index and also the activity of acid invertase enzyme was found to be the highest in bud chips collected from both top and middle portion of the cane and treated with BAP (50ppm). Bud chips collected from the bottom portion of the cane showed less germination percentage. Better germination and further establishment of the crop from the bud chips of top and middle portion of the cane might be due to the faster inversion of the sugars associated with higher activity of acid invertase in those portions of the cane.

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