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RESEARCH ARTICLE

EVALUATION OF EXOTIC AND INDIAN CLONES OF SUGARCANE FOR RATOONABILITY DURING WINTER

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Abstract

One hundred eighty five foreign hybrids from Queensland (Q), Barbados (B), Canal Point (CP), Hawaii (H), Puerto Rico (PR) and Fiji (LF) and 88 Indian hybrids (Co) were evaluated for ratoonability during winter months under subtropical Indian conditions. Ratooning during winter has adversely affected all the three traits studied viz. sprouting per cent, shoot height at 45th day and tillers/m at 45th day at different stages irrespective of categories of clones. Mean sprouting % after 45 days of ratooning during winter was the maximum in CP clones followed by Indian hybrids. LF and PR clones also showed above average sprouting % whereas Q and H clones showed below average. Better sprouting, in general, resulted in better shoot length especially during winter season. Mean shoot length and tillering potential of Co, CP and PR clones were above average, whereas these parameters were below average for Q and H clones. Sprouting % during winter and spring seasons were significantly correlated in CP clones only. Clones with better or on par sprouting % during winter, in comparison with spring ratooning, were identified from different categories of clones for utilization in breeding programmes.

Key words: *Foreign hybrids, Indian hybrids, subtropical India, winter ratooning, sprouting*

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Introduction

Sugarcane is an important cash crop of the world. As a long duration crop, generally 1-5 ratoons are grown in different regions of the world. Therefore, ability to ratoon constitutes a very important character of sugarcane varieties. The improvement in productivity of ratoon crop will tremendously enhance its competitiveness with other crops as ratoon crop results in a saving of about Rs 10,000 / acre towards the cost of cultivation (cost of preparatory tillage and seed), besides better sugar recovery at early stages of crushing under subtropical Indian conditions.

In north India, the temperatures during winter season may go as low as 0 - 5^{o}C which limits the ratoonability of the crop. The first ratoon crop is harvested during winter months, resulting in poor sprouting in the second ratoon crop. Genetic improvement for ratoonability is much more important under such harsh conditions of this region than in tropical India. Preliminary evaluation of different categories of sugarcane has indicated enough genetic variability for ratoonability during winter (Bakshi Ram *et al*. 2004, Sahi *et al*. 2002). However, concerted efforts are lacking on the part of the breeders of these states in identifying the clones tolerant to low temperature tolerance. There is a need to pay due attention to improve the ratoonability of sugarcane varieties, especially in winter harvested crops, and hence the present study was undertaken.

Materials and methods

The material for the study consisted of 185 foreign hybrids from Queensland (Q), Barbados (B), Canal Point (CP), Hawaii (H), Puerto Rico (PR) and Fiji (LF), and 88 Indian (Co) hybrids. A total of 273 clones was evaluated in alpha design (Mead 1997) with two replications. Thirty nine clones were planted in seven incomplete blocks to accommodate 273 clones in each replication. Each clone was space planted using single budded setts in two rows of 6 m length spaced at 0.90 m. One row of a plot was harvested / ratooned during the last week of December (winter) whereas another row was harvested during March (spring). Sprouting % was recorded 45 days after ratooning by counting the number of sprouted clumps in relation to total number of available clumps. Shoot length (up to leaf base) was recorded 45 days after ratooning, during June and July. Tillers per row were counted 45 days after ratooning and during July and figures were converted to tillers/m. Data were analyzed following standard statistical procedures.

Results and discussion

Mean performance of different categories of clones for various traits studied is presented in Table 1. Mean sprouting on 45th day of ratooning was higher in spring ratooned clones (75.56%) than in in winter ratooned clones (39.41%). During winter months, sprouting was the highest (51.16%) in CP clones followed by 48.72% in Co clones (Indian hybrids). LF and PR clones also showed sprouting levels above the overall mean value during winter. While the lowest sprouting during winter months was of Q clones (23.71%), H clones also showed sprouting below the mean value during winter;sprouting of B clones was, however, comparable to mean sprouting percent. During spring, LF, B and Co clones showed sprouting levels above the overall mean (75.56%). CP and PR clones, which showed above average sprouting during winter, showed below average sprouting during spring season. H and Q clones also showed below average sprouting during spring season under subtropical Indian conditions.

Both shoot growth and tillers/m were adversely affected in winter ratooning as indicated by much lower values for these traits on 45th day in comparison with spring ratooning (Table 1). Although the winter ratooned crop had the advantage of three months additional growth period, its shoot length remained lesser than spring ratooned crop even during July (grand growth stage). The average increase in shoot length from 45th day (February) to June in winter ratooned clones was 6.6 times whereas it was only 1.4 times in spring ratooning. Among the different categories of clones, increase in shoot length varied from six times in PR clones to 7.5 times in B clones in winter ratooning. There was not much difference in increase in shoot length from June to July irrespective of seasons. Better sprouting, in general, resulted in better shoot length especially during winter season. Mean shoot length of Co, CP and PR clones were above average whereas these were below average in Q and H clones. Almost similar trend was observed in spring harvested clones.

Average number of tillers/m increased from 1.62 on 45th day of ratooning to 5.18 in July in winter ratooned clones, an increase of 3.2 times (Table 1). Among different categories of clones, increase in tillers/m varied from 2.11 times in Q clones to 3.88 times in B clones. However, tillering was completed within 45 days of ratooning when ratooned during spring, as indicated by similar values at two dates. Number of tillers/m was the maximum in LF clones followed by PR clones on 45th day of ratooning. CP and Co clones also produced above average tillers/m. Tillering potential was poor in Q and H clones irrespective of ratooning time.

An inverse trend was observed for genotypic coefficients of variation (Table 2). CP clones, which showed the maximum sprouting during winter, showed the minimum variation whereas Q clones showed the maximum variation, particularly in in winter ratooning. In general, moderate to high GCV was observed in different categories of clones thereby indicating better scope for selection of clones with better ratooning potential during winter months. However, chances of selection are higher in CP, Co, PR and LF clones due to their higher sprouting percent.

Correlation coefficients amongst traits for ratoonability are presented in Table 3. In Indian hybrids (Co clones), sprouting % during winter and spring were not correlated with each other. In other words, clones showed better ratoonability during spring might not sprout well when harvested during winter and vice versa. This signifies the importance of the problem in subtropical Indian states which contributes more than 50% sugarcane in terms of area. However, sprouting % during winter was correlated with shoot length on 45th day and

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Table 1. Mean performance of different categories of clones

Category of clones	No. of clones sprouted		Sprouting % (after 45 days of harvest)		Shoot length 45 (after 45 days of harvest)		Shoot length in June (cm)		Shoot length in July (cm)		Tillers/m (after 45 days of harvest)		Tillers/m in July	
	Winter	Spring	Winter	Spring	Winter	Spring	Winter	Spring	Winter	Spring	Winter	Spring	Winter	Spring
Q clones	11	17	23.71	70.80	8.53	91.18	54.12	126.47	67.94	176.76	0.87	3.90	1.84	3.46
B clones	31	44	38.94	82.00	13.27	100.91	99.55	152.95	149.28	223.30	1.44	6.62	5.59	6.27
CP clones	40	48	51.16	71.52	20.08	110.10	134.37	162.19	186.15	226.98	1.93	7.80	6.54	7.85
H clones	20	27	27.80	68.10	9.63	92.96	62.03	134.63	95.74	196.85	0.74	3.25	2.67	3.69
PR clones	24	28	42.17	72.42	18.04	107.68	109.11	150.18	153.75	210.71	2.05	7.50	6.67	7.69
LF clones	18	21	43.36	82.14	15.14	121.43	111.19	172.14	155.47	226.67	2.46	7.36	6.23	7.30
Co clones	78	88	48.72	81.95	20.25	102.50	125.27	140.51	178.24	201.25	1.87	5.48	6.72	5.58
Total/Mean	**222**	**273**	**39.41**	**75.56**	**14.99**	**103.82**	**99.38**	**148.44**	**146.65**	**208.93**	**1.62**	**5.99**	**5.18**	**5.98**

Table 2. Coefficient of variation in different categories of clones

Category of clones	Sprouting % (after 45 days of harvest)		Shoot length (after 45 days of harvest)		Shoot length in June (cm)		Shoot length in July (cm)		Tillers/m (after 45 days of harvest)		Tillers/m in July	
	Winter	Spring	Winter	Spring	Winter	Spring	Winter	Spring	Winter	Spring	Winter	Spring
Q clones	142.85	38.52	149.12	30.69	126.07	25.88	132.98	23.54	168.97	149.49	170.11	107.23
B clones	88.44	26.68	90.35	27.85	59.88	23.62	57.91	19.46	121.53	98.64	97.67	80.06
CP clones	64.91	38.63	67.73	32.11	52.36	29.42	50.35	24.93	97.93	100.51	83.49	89.68
H clones	103.13	32.85	113.19	29.55	111.75	33.19	110.80	33.85	129.73	101.54	144.19	103.25
PR clones	81.22	44.73	74.56	38.99	68.14	36.87	65.53	30.83	119.02	96.40	98.95	77.76
LF clones	90.36	30.45	92.34	40.79	71.88	38.15	77.61	41.83	133.74	114.54	156.82	98.63
Co clones	75.84	26.99	68.79	26.14	43.82	29.10	39.98	27.62	133.69	87.77	98.66	63.24

tillers/m. This means that in those clones that sprout during winter, shoot growth and production of tillers might not be the problem; same was the case with B and LF clones.

Sprouting % during winter and spring seasons were significantly correlated in CP clones only. CP clones also showed the maximum sprouting during winter. This indicated reasonable possibility for any particular clone showing better ratoonability in both seasons. In CP clones, sprouting during two seasons was correlated with shoot lengths and tillers/m at different dates.

In H clones, sprouting during winter was not associated with any of the traits recorded in spring ratooned crop. Similarly, association was lacking between sprouting % during spring and other traits in winter ratooned crop. This means trait development varied in H clones when harvested during the two seasons. An almost similar trend was observed in PR clones, except that sprouting % in winter was correlated with tillers/m in July in spring ratooned crop. In Q clones sprouting during winter was correlated with tillers/m (at both dates in spring ratooned crop). This indicated the lack of problem in tillering during winter sprouted Q clones under subtropical Indian conditions.

Shoot length on 45th day between winter and spring ratooned crops was correlated in B, CP and LF clones indicating that the trend of shoot growth of these clones was similar irrespective of the season of rationing, whereas in Q, H, PR and Indian categories, different clones behaved differently when ratooned during winter and spring seasons. Shoot length of winter and spring ratooned crops was correlated during June and July in B, CP, LF and Co clones.

Number of tillers/m on 45th day in winter and spring ratooned crops was correlated in all categories, except in H clones. This indicated a different trend in tiller production up to 45 days in H clones alone. However, tillers/m during July showed association in winter and spring harvested crops in all categories of clones.

Ratooning during winter has resulted in decrease in mean values of various traits studied. Of these, sprouting up to 45th day of ratooning was the most important trait. Clones of different origin varied in their ratooning potential during winter. Reduction in mean sprouting during winter over spring ratooning was 47.8%, and it ranged from 28.5% in CP clones to 66.5% in Q clones. This trait could not be judged on the basis of evaluation during spring as indicated by lack of correlation for sprouting % during spring and winter seasons. This emphasized the need for evaluation of clones for their ratooning potential during winter season. However, there were clones in each category which showed sprouting % during winter on par with that of sprouting during spring. A few clones showed sprouting during winter better than the respective average sprouting during spring, *viz*. three each of Q and H, five each of B, LF and PR clones, 16 CP clones and 25 Co clones (Table 4). In terms of per cent, 40 % of CP clones showed better sprouting during winter than average sprouting % during spring (71.52%) followed by 32.1% of Indian hybrids.

It is not only the sprouting which was affected due to ratooning during winter, mean shoot length during July also showed reduction by 29.8% over mean shoot length of spring ratooned clones. Bakshi Ram *et al*. (2005) also reported lower values of number of millable canes per clump and cane length in winter ratooned seedlings of 12 crosses in comparison with spring ratooning. Q clones showed the maximum reduction (66.2%) in height, whereas it was the least in Co clones (11.4%). CP clones showed 18% reduction in shoot length during July in winter ratooned crop. Tillers/m was the least affected trait with 13.4% reduction in winter ratooned crop. The maximum reduction in tillers/m was 46.8% in Q clones whereas least reduction (10.9%) was observed in B clones. However, tillers/m increased by 20.4% in Co clones.

The results of the present study indicated that Indian hybrids suffered due to less sprouting potential when ratooned during winter. However, reduction in shoot length during July was the least in Co clones and tillers/m was not adversely affected due to winter ratooning. Hence, there is a need to improve sprouting of Indian cultivars during winter. This could be achieved by making crosses between better performing clones from diverse sources as identified in this study and evaluating the progenies for winter

Table 3. Correlation among traits for winter ratoonability in exotic and Indian hybrids

Winter ratooned	Category of clones	Spring ratooned					
		Sprouting % 45th day	Shoot length at			Tillers / m	
			45th day	June	July	45th day	July
Sprouting % (45th day)	Q clones	0.15	0.08	0.28	0.19	0.64**	0.66**
	B clones	0.27	0.46**	0.45**	0.32*	0.47**	0.45**
	CP clones	0.35*	0.53**	0.55**	0.52**	0.54**	0.54**
	H clones	-0.05	-0.02	0.01	-0.02	0.04	0.17
	PR clones	0.06	0.21	0.14	0.13	0.32	0.42*
	LF clones	0.38	0.72**	0.62	0.63**	0.72**	0.75**
	Co clones	0.00	0.38**	0.19	0.15	0.23*	0.29**
Shoot length (45th day)	Q clones	0.06	0.22	0.45	0.28	0.19	0.37
	B clones	0.32*	0.45**	0.46**	0.35*	0.38*	0.43**
	CP clones	0.34*	0.48**	0.50**	0.48**	0.52**	0.57**
	H clones	0.08	0.08	0.14	0.06	0.25	0.44*
	PR clones	0.12	0.26	0.24	0.21	0.22	0.31
	LF clones	0.43*	0.63**	0.62	0.60**	0.64**	0.61**
	Co clones	0.02	0.19	0.10	0.10	0.21*	0.27**
Shoot length (June)	Q clones	0.00	0.27	0.43	0.46	0.40	0.45
	B clones	0.25	0.43**	0.58	0.49**	0.37*	0.32*
	CP clones	0.39**	0.60**	0.67	0.65**	0.55**	0.57**
	H clones	0.10	0.22	0.22	0.15	0.16	0.36
	PR clones	0.21	0.38*	0.34	0.27	0.37*	0.48*
	LF clones	0.45*	0.76**	0.70**	0.62**	0.75**	0.75**
	Co clones	0.18	0.43**	0.42	0.41**	0.37**	0.40**
Shoot length (July)	Q clones	-0.00	0.24	0.43	0.30	0.39	0.44
	B clones	0.22	0.43**	0.57**	0.54**	0.36*	0.31*
	CP clones	0.34*	0.53**	0.63**	0.68**	0.48**	0.52**
	H clones	0.11	0.23	0.23	0.16	0.20	0.42*
	PR clones	0.20	0.34	0.26	0.22	0.36	0.47*
	LF clones	0.42	0.73**	0.67**	0.61**	0.72**	0.74**
	Co clones	0.15	0.40**	0.40	0.42**	0.32**	0.35**
Tillers / m (45th day)	Q clones	0.16	0.11	0.22	0.15	0.50*	0.52*
	B clones	0.33*	0.53**	0.46*	0.27	0.55**	0.57**
	CP clones	0.33*	0.49**	0.43**	0.33*	0.68**	0.65**
	H clones	0.16	0.13	0.15	0.08	0.21	0.36
	PR clones	0.30	0.29	0.38*	0.40*	0.37*	0.53**
	LF clones	0.39	0.81**	0.65**	0.57**	0.90**	0.89**
	Co clones	0.14	0.38**	0.26*	0.19	0.50**	0.56**
Tillers / m (July)	Q clones	0.33	0.34	0.53*	0.32	0.58*	0.64**
	B clones	0.35*	0.56**	0.56	0.46**	0.56**	0.62**
	CP clones	0.52**	0.64**	0.59**	0.58**	0.74**	0.76**
	H clones	0.24	0.28	0.23	0.19	0.27	0.46*
	PR clones	0.30	0.43*	0.43	0.41*	0.50**	0.66**
	LF clones	0.33	0.81**	0.63**	0.56**	0.94**	0.95**
	Co clones	0.27**	0.48**	0.39	0.36**	0.60**	0.66**

* Significant at 0.05; ** Significant at 0.01

Table 4. Elite clones with better sprouting during winter season than average sprouting during spring

Category of clones	Number of clones	Name of clones
Q clones	3 (27.3)*	Q 63, Q 69, Q 101
B clones	5 (16.1)	B33-54, B40-175, B44-130, B45-181, B47-225
CP clones	16 (40.0)	CP807, CP1165, CP29-230, CP31-511, CP33-243, CP33-425, CP36-105, CP43-47, CP44-101, CP46-115, CP50-11, CP50-61, CP61-37, CP63-354, CP63-372, CP63-384
H clones	3 (15.0)	H41-3340, H51-8194, H52-4610
PR clones	5 (20.8)	PR1000, PR1016, PR1040, PR1047, PR1056
LF clones	5 (27.8)	LF62-2810, LF64-2815, LF65-3662, LF69-767, LF69-801
Co clones	25 (32.1)	Co 923, Co 1270, Co 7915, Co 8316, Co 8339, Co 87028, Co 87263, Co 89029, Co 89036, Co 91020, Co 92002, Co 97009, Co 97015, Co 98017, Co 0231, Co 0238, CoJ 84291, CoJ 88, CoJ 88191, CoLk 92238, CoPant 94213, CoS 8436, CoS 93230, CoS 93259, BO 91
Total	62 (27.9)	

*Figures in parentheses indicate percentage of clones

ratoonability under subtropical Indian conditions. The ultimate aim of the breeding programme should be to improve sprouting, quick growth habit and more tillering potential in the subtropical sugarcane clones to help the farmers to take more than one ratoon crop in subtropical conditions so as to make the crop more remunerative and competitive.

References

Bakshi Ram, Sahi BK, Kumar P (2004) Database on winter ratoonability of sugarcane clones. Sugarcane Breeding Institute, Regional Centre, Karnal.

Bakshi Ram, Sahi BK, Hemaprabha G, Kumar P (2005) Effect of ratooning during winter and spring on selection in sugarcane seedlings. Indian J. Sugarcane Technol. 20: 52-56.

Mead R (1997) Statistical Methods for Plant Variety Evaluation (Ed. Kempton and Fox). Chapman & Hall, London: 40.

Sahi BK, Bakshi Ram, Kumar P (2002) Evaluation of sugarcane clones for ratoonability during winter months. Indian J. Sugarcane Technol. 17: 1-4.