Indian Journal of Agronomy **48** (4) : 312–315 (December 2003)

Tillering pattern, growth and productivity of promising sugarcane genotypes under various planting seasons and nitrogen levels in subtropical India

S.K. SHUKLA

Division of Crop Production, Indian Institute of Sugarcane Research, Lucknow, Uttar Pradesh 226 002

Received : February 2003

ABSTRACT

An experiment was conducted at the Indian Institute of Sugarcane Research, Lucknow, Uttar Pradesh, during 2000–2001 and 2001–2002 with 2 planting seasons (spring and summer), 3 genotypes ('Co H 94202', 'CoLk 9606' and 'CoLk 9617') and 3 nitrogen levels (112.5, 150 and 187.5 kg/ha). Higher tiller number, vigour and retention along with mean cane length (176.7 and 236.9 cm), cane diameter (2.46 and 2.23 cm) and cane weight (916.3 and 1106 g) were observed with spring planted cane than summer cane during both the cropping seasons respectively. Mean tiller population increased from 89,350/ha to 218,600/ha and 85,250 to 197,800/ha during first and second cropping seasons respectively. Thus higher tiller retention (66.6%) was observed during the first year than second year (52.9%). Genotype 'CoLk 9617' produced highest number of millable canes (153,500/ha and 114,020/ha during both the cropping seasons respectively), cane yield (92.19 and 109.4 tonnes/ha) and commercial cane sugar (10.72 and 12.95 tonnes/ha) and found superior to 'CoLk 94202' and 'CoLk 9606'. Spring planting produced highest cane (92.81 and 110.67 tonnes/ha) and commercial cane sugar (11.07 and 12.89 tonnes/ha) yields compared with the summer planting. The highest level of nitrogen also resulted in better tiller vigour, number and retention, besides better expression in growth parameters, cane (90.92 tonnes/ha and 103.75 tonnes/ha) and commercial cane sugar yields (10.69 and 12.59 tonnes/ha) during both the cropping seasons.

Key words : Sugarcane genotypes, Planting season, Nitrogen, Tiller retention, Millable cane, Cane yield, Commercial cane sugar, Quality parameters

The sugarcane plant has an excellent set of genetic, anatomical, physico-biochemical attributes and massive sugar storage capacity. It has very high potential to produce biomass and energy. Crop productivity and soil fertility are liable to change due to intensive and continuous cropping with application of fertilizers. In sub-tropical India, sugarcane is mainly planted in spring and summer seasons. Promising genotypes are being evolved through various approaches of plant breeding and evolving suitable/upgrading the agro-techniques holds the key for realizing high sugarcane productivity of the new genotypes.

Tillering period in sugarcane is the most important growth phase, which governs the cane yield in subtropical India. Normally sugarcane germination under subtropical conditions is 30–35% compared to 80–85% in tropical part of the country. When sugarcane planting is delayed from February to April/May, it gets lesser time for tillering and productivity (Verma *et al.,* 1996; Pandey and Shukla, 2001). Keeping the above points in view, present experiment was conduced to evaluate the performance of promising genotypes under various planting seasons and nitrogen levels to examine the impact of increased nitrogen fertilization on tillering and subsequently on yield.

MATERIALS AND METHODS

An experiment was conducted during 2000–2001 and 2001–2002 at Indian Institute of Sugarcane Research, Lucknow, to evaluate 3 sugarcane genotypes ('CoH 94202', 'CoLk 9606' and 'CoLk 9617') under 2 planting seasons (spring and summer) and three nitrogen levels (112.5, 150 and 187.5 kg N/ha) with a view to identifying suitable genotype under both the seasons and evaluate the impact of higher N levels vis-a-vis the seasons effect. The treatment of planting seasons was kept in main plot, genotypes in sub-plots and nitrogen levels in sub-sub-plots. Thus, eighteen treatments were replicated 3 times in split-split design. Spring and summer crops were planted at 75 cm and 60 cm (row to row) respectively. The experimental field was sandy loam with low available nitrogen (210 kg/ha) and medium in phosphorus (14.6 kg/ha) and potassium (220 kg/ha) and pH 7.50. Planting of spring and summer crops were done in the second week of

Table 1. Tiller population ('000/ha) in sugarcane plant crop during 2 cropping seasons (2000–2001 and 2001–2002)

Treatment	Tiller population ('000/ha)									
	May		June		July		August		September	
	2000–2001	2001–2002	2000–2001	2001–2002	2000–2001	2001–2002	2000–2001	2001–2002	2000–2001	2001–2002
Planting season										
Spring	98.1	89.3	166.6	127.6	201.5	204.4	212.3	180.5	188.9	166.3
Summer	80.6	81.2	159.2	141.9	206.8	191.3	225.0	160.1	229.6	144.7
CD (P=0.05)	9.50	7.50	NS	4.80	34.78	7.15	NS	6.20	NS	6.65
Genotype										
'CoH 94202'	87.4	81.5	160.5	134.1	206.0	195.5	218.7	160.4	209.4	133.6
'CoLk 9606'	80.8	78.8	147.9	128.3	195.5	184.7	209.6	160.3	199.6	160.4
'CoLk 9617'	103.38	92.4	180.3	141.8	210.9	213.4	207.7	190.2	218.7	172.5
CD (P=0.05)	6.49	6.50	7.94	6.10	3.83	8.20	3.04	7.10	4.08	7.80
N (kg/ha)										
112.5	92.1	85.5	141.3	128.8	195.9	189.6	212.4	160.2	203.8	150.5
150.0	90.2	83.6	164.4	134.5	203.5	198.7	217.7	170.5	209.6	154.3
187.5	88.9	86.6	182.9	140.9	212.9	205.3	225.8	180.2	214.3	161.7
CD (P=0.05)	NS	NS	7.67	2.90	2.96	4.51	1.58	4.90	2.14	3.50

Table 2. Influence of planting seasons and nitrogen levels on growth and yield of promising sugarcane genotypes during 2 cropping seasons (2001–2001 and 2001–2002)

Treatment	Germination (%)		Millable canes ('000/ha)		Cane length (cm)		Cane diameter (cm)		Cane weight (g)		Cane yield (tonnes/ha)	
	2000–2001	2001–2002	2000–2001	2001–2002	2000–2001	2001–2002	2000–2001	2001–2002	2000–2001	2001–2002	2000–2001	2001–2002
Planting season												
Spring	61.47	56.95	135.7	109.2	186.67	236.9	2.46	2.23	916.3	1106	92.81	110.67
Summer	40.48	40.55	155.6	100.1	168.52	223.7	2.20	2.14	784.4	856	80.19	82.25
CD (P=0.05)	3.34	4.40	13.43	6.20	17.99	8.10	0.32	0.15	26.04	70.85	7.51	6.70
Genotype												
'CoH 94202'	49.24	47.85	143.89	91.24	161.67	219.7	2.09	2.31	753.3	832	79.91	80.05
'CoLk 9606'	45.48	44.58	139.51	99.20	175.56	236.5	2.53	2.15	824.4	1033	87.41	94.90
'CoLk 9617'	58.21	53.82	153.5	114.02	195.56	249.8	2.37	2.09	973.3	1078	92.19	109.4
CD (P=0.05)	12.72	5.80	3.78	7.30	5.71	10.20	0.13	0.18	35.18	75.60	5.63	8.50
N (kg/ha)												
112.5	51.84	48.41	141.97	96.48	168.33	225.7	2.17	2.08	784.4	904	81.96	86.59
150.0	50.76	47.12	145.86	106.38	178.33	235.4	2.37	2.24	852.2	997	90.92	103.75
187.5	50.33	50.12	149.1	111.60	186.11	244.9	2.44	2.23	914.4	1042	86.63	99.01
CD (P=0.05)	4.30	3.90	0.67	4.80	2.83	7.20	0.06	0.06	18.38	42.60	2.28	4.50

Table 3. Influence of planting seasons and nitrogen levels on juice quality of promising sugarcane genotypes during 2 cropping seasons (2001–2001 and 2001–2002)

Treatment	Juice brix (%)		Pol (%) in juice		Juice purity (%)		Commercial cane sugar (tonnes/ha)	
	2000–2001	2001–2002	2000–2001	2001–2002	2000–2001	2001–2002	2000–2001	2001–2002
Planting season								
Spring	18.44	18.62	16.94	16.68	91.86	89.58	11.07	12.89
Summer	18.41	18.37	16.78	16.98	91.15	92.43	9.44	9.86
CD (P=0.05)	NS	NS	NS	NS	NS	NS	1.20	1.10
Genotype								
'CoH 94202'	18.3	18.96	16.89	17.16	92.29	90.50	9.52	9.60
'CoLk 9606'	18.2	18.90	16.91	16.70	92.91	88.36	10.46	10.95
'CoLk 9617'	18.86	17.62	16.77	16.62	88.92	94.32	10.72	12.95
CD (P=0.05)	NS	NS	NS	NS	NS	NS	0.82	1.20
N level (kg/ha)								
112.5	18.06	18.82	16.73	17.03	92.63	90.49	9.69	10.31
150.0	18.59	18.74	17.02	16.51	91.55	88.10	10.37	11.29
187.5	18.62	17.92	16.83	16.94	90.39	94.53	10.69	12.59
CD (P=0.05)	NS	NS	NS	NS	2.07	NS	0.32	0.52

February and April respectively. Number of tillers was counted from May to September during both the cropping seasons. Five canes were randomly selected from each plot and observations on cane length, diameter and weight were recorded.

These samples were crushed and juice quality (brix, pol and purity) was analysed.

RESULTS AND DISCUSSION

Planting season

Tiller population in sugarcane was influenced greatly by different treatments (Table 1). The production of tillers increased up to July. After that, population of tillers decreased due to shoot mortality induced by intense crop competition resulting from high temperature along with high humidity. It brought forth sugarcane into the elongation phase. Similar trend was observed during both the cropping seasons. There was a sudden spurt in tiller production during May–June. The increase ranged 1.82 and 1.58 times during first and second year respectively. Conducive temperature and irrigation application caused a flush in sugarcane growth. Initially, in May and June, spring crop produced higher number of tillers than summer crop. It was due to longer time available for spring crop which faced conducive temperature than April planted crop, which otherwise went through harsh environmental conditions in subtropical India during germination phase. Higher germination was recorded in spring crop than in the summer crop during both the cropping seasons (Table 2). Mean cane length, cane diameter and cane weight was higher with spring planted cane than summer cane. It was due to longer period and favourable temperature for germination and tillering available under spring planting season. The results are in close conformity with the findings of Verma *et al.* (1996) and Shukla and Lal (2002). Sugarcane juice quality was not significantly affected with planting seasons (Table 3). Spring planting resulted in the highest cane yield and CCS over summer crop (Table 3). In the second year, greater increase in cane yield (34.55%) was observed with spring planting than summer planting compared to first season (15.73%).

Genotype

Genotype 'CoLk'9617' produced higher number of tillers over entire tillering period than the other genotypes (Table 1). This genotype also showed higher survival rate and vigorous millable canes. Thus, 'CoLk 9617' showed capability of producing higher number of millable canes earlier in the life cycle. Thus this mid-late genotype achieved early bulkiness/tonnage build up characteristic too. Other workers earlier reported the response of manipulations of agro-techniques on productivity of sugarcane genotypes (Singh, 1993; Shukla *et al.*, 1998; Pandey and Shukla, 2001). Among various sugarcane genotypes, 'CoLk 9617' produced higher number of millable canes and also produced longer canes than 'CoLk 9606' and 'CoH 94202'. Overall mean cane weight was too higher with 'CoLk 9617'. Different genotypes did not differ in juice quality significantly (Table 3), though higher cane and commercial cane sugar yields were obtained with 'CoLk 9617'.

Nitrogen

Increasing nitrogen levels increased tiller production

significantly (Table 1). Moreover, higher dose of nitrogen also reduced tiller mortality indicating that besides tiller production capability of the genotypes, nitrogen nutrition also helped and maintained the retention of tillers. The role of nitrogen in chlorophyll formation and carbohydrate metabolism was main reason for the improvement in tiller growth, vigour and retention.

Increasing nitrogen levels from 112.5 kg N/ha to 187.5 kg N/ha increased the number of millable canes, length, diameter and cane weight significantly, as it exercised positive effects on growth and development plant processes (Singh *et al.,* 1990; Shukla and Lal, 2002). The level of 187.5 kg N/ha improved the cane weight by 16.57% and 15.26% respectively over 112.5 kg N/ha over the 2 seasons. The highest level of nitrogen produced the maximum cane (90.92 tonnes/ha) and CCS yields (10.69 and 12.59 tonnes/ha). Juice quality did not undergo tangible change with nitrogen levels (Table 3). However, the turn out of commercial cane sugar (CCS) increased with increasing levels of nitrogen. Commercial cane sugar was the function of quality parameters like pol% in juice and cane yield and in the present study the contribution of cane yield was higher than quality parameters.

REFERENCES

Pandey, M.B. and Shukla, S.K. 2001. Response of sugarcane (*Saccharum* spp hybrid complex) to planting seasons and nitrogen levels. *Indian Journal of Agricultural Sciences* **71**(4) : 261–263.

Shukla, S.K. and Lal, Menhi. 2002. Competition functions and productivity in sugarcane-based associative and successive cropping systems in relation to N and S nutrition. *Indian Journal of Agricultural Sciences* **72**(6) : 315–318.

Shukla, S.K., Verma, R.S., Singh, G.B. and Verma, Lal Jee. 1998. Tillering pattern of mid late sugarcane varieties as influenced by different agro-techniques. *Indian Sugar* (November), pp. 581–584.

Singh, G., Singh, O.P., Singh, R.S. and Yadav, R.A. 1990. Response of sugarcane to planting seasons and fertility levels. *Indian Journal of Agronomy* **35**(3) : 315–316.

Singh, H.N. 1993. Role of varieties in enhancing sugar productivity. *Indian Journal of Sugarcane Technology* **35**(3) : 315–316.

Verma, R.S., Shukla, S.K., Singh, G.B. and Verma, Lal Jee. 1996. Agro-techniques to enhance sugarcane productivity of mid-late varieties for early crushing. *Indian Journal of Sugarcane Technology* **11**(1) : 38–41.