*Indian Journal of Agricultural Sciences* **84** (10): 1280–3, October 2014/Short Communication

# Growth, yield and quality of mid late and late varieties of sugarcane (*Saccharum spp* complex hybrid) as influenced by row spacing and fertility levels

RAVINDRA SINGH[1], ARVIND MISHRA[2] and A S GODARA[3]

*Sugarcane Breeding Institute, Regional Centre, Karnal, Haryana 125 004*

Received: 28 January 2013; Revised accepted: 8 July 2014

**Key words:** Commercial cane sugar, Fertility levels, Mid late and late varieties, Millable canes Recommended dose of fertilizer (RDF), Ratoon

Sugarcane (*Saccharum* spp complex hybrid) is primarily a tropical crop even though it occupies 67% of the 4.9 million ha cropped area in subtropical zone of country. If we compare the sugarcane productivity in tropical and sub tropical states, the productivity levels are 102.5 tonnes/ha in Tamil Nadu, whereas it is 56.7 tonnes/ha in Uttar Pradesh showing huge gap in productivity. Besides poor climatic suitability, non = availability and adoption of appropriate cultivars with their specific agro-recommendations are the major impediments of higher productivity in this region. There is much scope to enhance productivity by adopting high yielding genotypes of different maturity groups under proper nutrient and density management practices. There is a differential response of the genotypes to higher level of nutrients due to differential genetic potentiality of the particular genotypes (Sinha *et al*. 2005). Keeping these points in view, the present study was undertaken to find out the optimum row spacing and fertilizer levels of newly evolved four mid-late and late maturing cultivars of the Sugarcane Breeding Institute (SBI), Regional Centre, Karnal for North Western Zone of the country.

An experiment was conducted at SBI, Regional Centre, Karnal during cropping season of 2007-2009 in sandy loam soil having 252.4, 16.5 and 276 kg/ha available N, P and K, respectively**.** Treatments consisting of five varieties of mid-late and late maturing group, i e Co 0121, Co 0123, Co 0124, Co 0241 and CoS 767 (standard), two row spacing of 75 and 90 cm and three fertility levels, i.e. 75% ($N_{112.5}$ $P_{16.2}$ $K_{31.1}$ kg/ha), 100% ($N_{150}$ $P_{21.8}$ $K_{41.5}$ kg/ha) and 125% ($N_{187.5}$ $P_{27.3}$ $K_{51.8}$ kg/ha) of recommended doses of fertilizer (RDF) were tested in split plot design by keeping row spacing and fertility levels in main plots and varieties in sub plots with three replications. Plant crop was planted on 14 March 2007 and harvested in the last week of March 2008. Full doses of phosphorus and potash were applied at the time of planting as per treatments while nitrogen was applied in three equal split at planting, 90 and 150 days after planting. Plant crop was ratooned and raised as per recommended crop protection and production management practices. Ratoon crop was harvested in the first week of February 2009. The biometric observations on plant as well as ratoon crop were recorded at harvest based on 5 randomly selected millable canes. The quality parameters for sugarcane were determined at the harvest of both the crops as per the method of Meade and Chen (1977). Cane yield of plant as well as ratoon crop was recorded on the basis of net plot size and is converted in tonnes per hectare (tonnes/ha). Sugar yield was calculated as; sugar yield (tonnes/ha) = [S-0.4(B-S)×cane yield (tonnes/ha)/100]; where S and B are sucrose and brix per cent in cane juice, respectively. Net return and B: C ratio were computed on the basis of cost of inputs and prices of outputs prevailed during experimentation year.

Closer row spacing (75 cm) produced significantly higher shoot populations of plant crop at 90 and 120 days, however, it did not reflect in final cane yield due to higher mortality of shoots at closer spacing as well as comparatively lesser cane length and thickness than 90 cm spacing (Table 1). Commercial cane sugar yield and juice quality were also not altered significantly by row spacing. Similar results were also reported by Mahadevaswamy (1997). Ratoon crop also responded to varying plant densities maintained by altering the row spacing (Table 2). Yield attributes, viz. cane length and girth were indifferent with row spacing, while number of millable canes (NMC) increased by 10.5% at closer row spacing (75 cm) than normal spacing (90 cm). Singh *et al.* (2005) also found higher number of NMC at closer spacing. Cane yield of ratoon was significantly higher (59.8 tonnes/ha) at closer row spacing of 75 cm than 90 cm spacing due to more number of millable cane per unit area obtained from closer spacing. These results were in close

[1] Senior Scientist (Agronomy) (e mail: mahla_rs@yahoo.com), NRCSS, Tabiji, Ajmer, Rajasthan 305 206; [2] Principal Scientist (Agronomy); [3] Agriculture Research Officer (e mail: godara_as@yahoo.com), ATC, Tabiji, Ajmer, Rajasthan 305 206

Table 1 Effect of row spacing, fertility levels and varieties on growth attributes, juice quality, cane yield, sugar yields and economics of plant crop

| Treatment | Germination at 30 days | Shoot counts '000'/ha 90 days | Shoot counts '000'/ha 120 days | Cane length (cm) | Cane diameter (mm) | NMC ('000/ha) | Cane yield (tonnes/ha) | Sucrose (%) | Purity (%) | CCS (tonnes/ha) | Cost of cultivation (₹×10³ ha) | Net returns (₹×10³ ha) | B:C ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Row spacing* | | | | | | | | | | | | | |
| 75 cm | 41.6 | 108.4 | 131.5 | 175 | 23.9 | 81.0 | 58.5 | 20.52 | 92.9 | 8.48 | 58.73 | 24.81 | 1.42 |
| 90 cm | 42.4 | 101.5 | 119.7 | 180 | 24.2 | 76.9 | 57.1 | 20.37 | 92.7 | 8.19 | 58.73 | 22.81 | 1.39 |
| CD (P=0.05) | NS | 6.8 | 8.2 | NS | NS | NS | NS | NS | NS | NS | | | |
| *Fertility levels* | | | | | | | | | | | | | |
| 75% of RDF | 41.8 | 102.4 | 113.8 | 168 | 23.6 | 74.2 | 54.1 | 20.51 | 92.9 | 7.85 | 57.97 | 19.28 | 1.33 |
| 100 % of RDF | 41.0 | 105.2 | 127.9 | 176 | 24.3 | 80.8 | 58.9 | 20.40 | 92.8 | 8.49 | 58.73 | 25.68 | 1.43 |
| 125% of RDF | 43.2 | 107.5 | 135.3 | 185 | 24.5 | 82.6 | 60.6 | 20.34 | 92.7 | 8.71 | 59.50 | 27.04 | 1.45 |
| CD (P=0.05) | NS | 7.5 | 8.4 | 5.1 | 0.85 | 5.5 | 5.2 | NS | NS | 0.68 | | | |
| *Varieties* | | | | | | | | | | | | | |
| Co 0121 | 42.8 | 110.2 | 135.6 | 193 | 25.8 | 82.5 | 69.1 | 20.85 | 93.6 | 10.22 | 58.73 | 39.94 | 1.68 |
| Co 0123 | 41.7 | 86.1 | 106.9 | 179 | 24.9 | 78.4 | 59.3 | 20.59 | 93.7 | 8.67 | 58.73 | 25.95 | 1.44 |
| Co 0124 | 43.9 | 108.3 | 114.8 | 145 | 24.1 | 75.8 | 37.4 | 21.20 | 93.3 | 5.62 | 58.73 | -5.32 | 0.91 |
| Co 0241 | 44.0 | 111.3 | 137.5 | 191 | 23.7 | 80.8 | 64.9 | 20.68 | 93.4 | 9.52 | 58.73 | 33.95 | 1.58 |
| CoS767 | 40.2 | 109.2 | 135.3 | 180 | 22.2 | 77.2 | 58.4 | 18.68 | 90.3 | 7.62 | 58.73 | 30.95 | 1.42 |
| CD (P=0.05) | 3.50 | 8.4 | 8.8 | 4.8 | 0.91 | 5.00 | 4.35 | 0.64 | 1.25 | 0.62 | | | |

* RDF (Recommended dose of fertilizer NPK 150:21.8:41.5 kg/ha); NMC (Number of millable canes); CCS (Commercial cane sugar)

Table 2 Effect of row spacing, fertility levels and varieties on growth attributes, juice quality, cane yield, sugar yields and economics of ratoon crop

| Treatments | Shoot counts ('000/ha) 90 days | Shoot counts ('000/ha) 120 days | Cane length (cm) | Cane diameter (mm) | NMC ('000/ha) | Cane yield (tonnes/ha) | Sucrose (%) | Purity (%) | CCS (tonnes/ha) | Cost of cultivation (₹×10³ ha) | Net returns (₹×10³ ha) | B:C ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Row spacing* | | | | | | | | | | | | |
| 75 cm | 86.33 | 121.82 | 173 | 23.9 | 82.0 | 59.8 | 18.12 | 90.3 | 7.57 | 37.57 | 47.82 | 2.27 |
| 90 cm | 79.88 | 105.65 | 178 | 24.2 | 74.2 | 54.2 | 18.56 | 90.8 | 7.03 | 37.57 | 39.83 | 2.06 |
| CD (P=0.05) | 7.21 | 9.78 | NS | NS | 5.9 | 4.6 | NS | NS | NS | | | |
| *Fertility levels* | | | | | | | | | | | | |
| 75% of RDF | 79.19 | 110.12 | 165 | 23.5 | 72.8 | 53.0 | 18.62 | 91.0 | 6.92 | 36.64 | 39.04 | 2.07 |
| 100 % of RDF | 84.11 | 116.52 | 174 | 24.2 | 79.6 | 58.2 | 18.38 | 89.9 | 7.50 | 37.57 | 46.54 | 2.21 |
| 125% of RDF | 86.02 | 119.12 | 187 | 24.5 | 82.0 | 59.8 | 18.03 | 89.7 | 7.50 | 38.70 | 46.69 | 2.21 |
| CD (P=0.05) | 7.48 | 10.24 | 4.7 | 0.5 | 3.7 | 2.1 | NS | NS | NS | | | |
| *Varieties* | | | | | | | | | | | | |
| Co 0121 | 83.25 | 112.35 | 188 | 25.8 | 79.4 | 65.4 | 18.18 | 90.1 | 8.30 | 37.57 | 55.82 | 2.49 |
| Co 0123 | 70.69 | 84.88 | 174 | 24.7 | 74.5 | 52.8 | 18.22 | 90.1 | 6.71 | 37.57 | 37.83 | 2.01 |
| Co 0124 | 83.25 | 116.26 | 142 | 23.9 | 73.5 | 36.5 | 18.70 | 90.5 | 4.77 | 37.57 | 14.55 | 1.39 |
| Co 0241 | 84.18 | 130.25 | 190 | 23.8 | 81.2 | 67.2 | 19.00 | 91.7 | 9.00 | 37.57 | 58.39 | 2.55 |
| CoS767 | 94.15 | 132.5 | 183 | 22.3 | 82.0 | 62.8 | 17.30 | 90.2 | 7.59 | 37.57 | 52.11 | 2.39 |
| CD (P=0.05) | 8.12 | 10.69 | 4.5 | 0.6 | 4.6 | 3.2 | 0.58 | 1.0 | 0.62 | | | |

conformity with findings of Singh *et al.* (2011). Sucrose per cent was better at wider row spacing of 90 cm (18.56%) than closer row spacing of 75 cm (18.12%), however, sugar yield was 7.7% more at 75 cm due to higher cane yield/ha. The maximum net return of ₹ 24 810 and ₹ 47 820 and benefit: cost ratio of 1.42 and 2.27 were recorded with closer planting (75 cm) from plant and ratoon crop, respectively.

Successive increase in fertility levels improved the growth, yield attributes and cane yield of plant crop (Table 1). Application of 125% RDF, being at par with 100% RDF produced 12.1 and 2.9% more cane yields than 75 and 100% fertility levels, respectively. Growth and yield parameters of sugarcane improved significantly with 150 kg N/ha (Singh *et al.* 2005). Similarly, Significantly higher tillers, cane length, dry matter accumulation, cane diameter,

number of millable canes and cane yield were obtained with the application of 125% RDF (Kumar *et al*. 2012). Progressive decrease in sucrose and purity percent of juice was observed with increase in doses of fertilizers; however, differences were not significant. Application of 125% of RDF recorded 2.59% and 10.95% higher sugar yields than 100% and 75% of RDF. Shukla *et al*. 2002 reported that cane yield increased with increasing the nitrogen level from 100 to 200 kg/ha. Likewise, increasing fertility levels increased the ratoon yield attributes and cane yield (Table 2). Application of 125% RDF improved number of millable cane (82 000/ha), cane length (187 cm) and diameter (24.5 cm) in significant manner. Cane yield was enhanced by 12.83% and 2.75% over 75 and 100% RDF, respectively. Sucrose percentage in juice decreased with increasing fertility levels. At both 100 and 125% fertility level sugar yield was equal (7.5 tonnes/ha) and it was 8.3% higher than 75% fertility levels. Application of 125% RDF fetched maximum net return ₹ 27 040 and ₹ 46 690 with highest benefit: cost ratio of 1.45 and 2.21 from plant and ratoon crop, respectively.

Table 3 Effect of fertility levels × varieties interaction on cane yield of plant and ratoon crop

| Treatment | *Varieties* | | | | | |
|---|---|---|---|---|---|---|
| | Co 0121 | Co 0123 | Co 0124 | Co 0241 | CoS767 | Mean |
| | | | *Plant crop* | | | |
| *Fertility levels* | | | | | | |
| 75% RDF | 65.7 | 55.2 | 39.9 | 61.6 | 52.0 | 52.1 |
| 100% RDF | 69.4 | 60.6 | 38.2 | 65.4 | 60.8 | 60.9 |
| 125% RDF | 69.2 | 56.5 | 37.2 | 71.6 | 64.1 | 59.7 |
| Mean | 68.1 | 57.4 | 38.4 | 66.2 | 58.9 | 57.6 |
| CD (P=0.05) | 5.04 | | | | | |
| | | | *Ratoon crop* | | | |
| *Fertility levels* | | | | | | |
| 75% RDF | 61.5 | 48.2 | 34.8 | 61.7 | 58.5 | 53.0 |
| 100% RDF | 65.5 | 53.8 | 37.5 | 68.3 | 66.0 | 58.2 |
| 125% RDF | 69.2 | 56.5 | 37.2 | 71.6 | 64.1 | 59.7 |
| Mean | 65.1 | 52.8 | 36.5 | 67.2 | 62.9 | 56.9 |
| CD (P=0.05) | 5.33 | | | | | |

Significant variations were recorded in growth, cane yield and juice quality parameters of plant crop due to varieties (Table 1). Varieties differ significantly in tillers production. Co 0241, Co 0121 and CoS 767 were at par in tillers count with Co 0124 at 90 days, however at 120 days varieties Co 0241, Co 0121 and CoS 767 had significantly more number of tillers than Co 0124. Although, Co 0121 and Co 0241 were at par in cane length and NMC but cane thickness was significantly more in former than the later. Maximum cane yield was recorded in Co 0121 (69.1 tonnes/ha) followed by Co 0241 (64.9 tonnes/ha) and both were significantly superior to Co 0123, Co 0124 and CoS 767 (standard). Co 0124 produced the lowest cane yield due to shorter cane height and value was even 35.9% lower than CoS 767. All the promising cultivars outperformed in sucrose per cent than CoS 767. Co 0124 gave highest sucrose per cent followed by Co 0121, Co 0241 and Co 0123 but differences were not significant. The maximum and significantly higher sugar yield was obtained from Co 0121 (10.22 tonnes/ha) than all other genotypes. Co 0124 gave the lowest sugar yield (5.62 tonnes/ha) due to low cane yield. Significant variations in yield attributes and cane yield were also observed among genotypes by Shukla (2007). Ratoon of variety Co 0241 produced highest cane yield (67.2 tonnes/ha) followed by Co 0121 and was significantly better than other varieties including standard check. Co 0241 also proved to be excellent ratooner as it gave 3.5% higher cane yield than its plant crop. Ratoon cane yield in Co 0121 was only 3.7 tonnes/ha lower than that recorded in plant crop. Co 0123 was found poor ratooner as ratoon cane yield declined by 10.67% than its plant crop. All the tested promising varieties recorded significantly higher sucrose % than standard CoS 767. Sugar yield was maximum in Co 0241 (9.0 tonnes/ha) followed by Co 0121 (8.30 tonnes/ha) and both in turn were significantly better than Standard CoS 767 (7.6 tonnes/ha). Kadam *et al.* (2007) also reported that varieties differ in their ratooning potential. Variety Co 0121 fetched highest net return ₹ 39 940 and B:C ratio1.68 followed by genotype Co 0241 (net return ₹ 33 950 and B:C ratio 1.58) in plant crop and reverse trend was observed in ratoon crop with highest net return (₹ 58 390) and B:C ratio (2.55) from Co 0241. However, under plant-ratoon system as a whole variety Co 0121 was found superior in terms of net return (₹ 95 760) with highest B:C ratio (1.99) than Co 0241.

A significant interaction between fertility levels and varieties was observed (Table 3). Variety Co 0121 gave significantly higher cane yield at 125% RDF as compared to 75% RDF in the plant crop. While variety Co 0241 produced higher cane yield (71.6 tonnes/ha) with application of 125% RDF in the ratoon crop, which was significantly superior over genotypes CoS 767, Co 0124 and Co 0123 except Co 0121 at same level of fertility, i.e.125% RDF.

## SUMMARY

A field experiment was conducted to assess performance of newly developed five mid late and late sugarcane cultivars, i.e. Co 0121, Co 0123, Co 0124 and Co 0241 along with CoS 767(standard) with two row spacing (75 and 90 cm) under three fertility levels, i.e. 75, 100 ($N_{150}$ $P_{21.8}$ $K_{41.5}$) and 125% of recommended dose of fertilizers (RDF) with plant-ratoon system. Varieties Co 0121 and Co 0241 recorded the maximum and significantly higher cane yield (69.1 and 67.2 tonnes/ha) and commercial cane sugar (10.22 and 9.00 tonnes/ha) in plant and ratoon crop, respectively. In ratoon crop number of millable canes (NMC) and cane yield increased substantially by 10.5 and 10.3 per cent, respectively with 75 cm row spacing. Closer spacing fetched maximum net return (₹ 24 810 and ₹ 47 820) with benefit: cost ratio of 1.42 and 2.27 with plant as well as ratoon crop, respectively. Fertility level of 125% RDF, being at par with 100% RDF registered improvement in yield attributes and produced increased cane yield and CCS

both from plant as well as ratoon crop over 75% RDF. Except varieties, the quality parameters did not undergo significant variation due to change in row spacing and fertility treatments. Cultivar×fertility level interactions indicated that varieties Co 0121 and Co 0241 were equally productive at normal fertility level of 100% RDF.

## REFERENCES

Kadam U A, More S M and Kadam B S. 2007. Evaluation of pre-seasonal sugarcane genotypes for cane yield and quality parameters in South Maharashtra. *Cooperative Sugar* **39**(1): 41–5.

Kumar N, Singh H, Kumar R and Singh V P. 2012. Productivity and profitability of different genotypes of sugarcane (*Saccharum* spp. hybrid complex) as affected by fertility levels and planting seasons. *Indian Journal of Agronomy* **57**(2): 180–5.

Mahadevaswamy M.1997. Effect of nitrogen and row spacing on growth, yield and quality of sugarcane (*Saccharum officinarum*) varieties. *Indian Journal of Agronomy* **41**(3): 457–61.

Meade, G P and Chen, J C P. 1977. *Cane Sugar Hand book*, 10th Edition, p 405.Wiley-Inter science, Publication, New York.

Shukla S K. 2007. Growth, yield and quality of high sugarcane (*Saccharurn officinarum*) genotypes as interlaced due to planting seasons and fertility levels. *Indian Journal of Agricultural Sciences* **77**(9): 569–73.

Shukla S K, Lal Menhi and Lal M. 2002. Competition functions and productivity in sugarcane based associative and successive cropping system in relation to nitrogen and sulphur nutrition. *Indian Journal of Agricultural Sciences* **72**(6): 315–8.

Singh A K, Lal Menhi and Srivastava T K. 2005. Enhancing productivity and sustainability of sugarcane plant-ratoon system through planting geometry, dual-purpose legume intercropping and nitrogen nutrition. *Indian Journal of Agronomy* **50**(4): 285–8.

Singh W, Singh R, Malik R P and Mehta R. 2011. Effect of planting density and weed management options on weed dry weight and cane yield of spaced transplanted sugarcane (*Saccharum officinarum* L.) after wheat harvest in sub tropical India. *Indian Journal of Weed Sciences* **43**: 97–100.

Sinha U P, Singh H and Singh B K. 2005. Effect of genotypes and fertility levels on growth, yield and quality of sugarcane under rainfed condition. *Indian Sugar* **55**(7): 23–6.