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# EVALUATION OF NEW CANDIDATE SUGARCANE VARIETIES FOR SOME QUALITATIVE AND QUANTITATIVE TRAITS UNDER THATTA AGRO-CLIMATIC CONDITIONS

M. Y. Arain, R. N. Panhwar, N. Gujar, M. Chohan, M. A. Rajput, A. F. Soomro and S. Junejo
National Sugar Crops Research Institute, PARC Makli Thatta
Corresponding author e-mail: younisarain@hotmail.com

## ABSTRACT

During 2001-02, 2002-03 and 2003-04 crop seasons performance of eleven promising candidate sugarcane varieties obtained from different Sugarcane Research Institutes of Pakistan along with local check Thatta-10 was tested in plant and ratoon crops at National Sugar Crops Research Institute, Farm Thatta. It was observed that none of the varieties in the trial could succeed the check variety in terms of cane yield and commercial cane sugar percentage. The average results of the plant crop for 2001-02 and 2002-03 crop seasons revealed that variety Thatta-10 showed superiority over rest of the varieties by giving maximum average cane yield of 116.77 t $ha^{-1}$. The results further revealed that the check variety Thatta-10 remained high sugar content variety with average CCS 12.74%. The cane yield data for succeeding ratoon crop during 2003-04 revealed that check variety Thatta-10 maintained its superiority by producing maximum average cane yield of 110.33 t $ha^{-1}$ and CCS 12.93%.

**Key words:** Sugarcane, Check variety, Ratoon crop, Commercial cane sugar (CCS).

## INTRODUCTION

Sugarcane crop is currently facing severe crisis in the country and both farming community and the industry are striving for its sustainable existence and growth. The major challenges faced by the crop are lower than average per area production, low sugar recovery and higher cost of production. Regardless of pronounced developments in sugarcane research and expansion in sugar industry, our national average sugarcane yield is 49.00 tones per hectare, whereas, the potential is between 150-250 tones per hectare at research stations and progressive grower's farms (Akhtar *et al.,* 2003). There are number of reasons for lower cane yield and one of those is the planting of low yielding varieties. Therefore, it is need of the time to introduce new high yielding varieties with good ratoonability in the country (Chattha and Ehsanullah, 2003). Variety plays a key role in both increasing and decreasing per unit area sugar yield, while use of unapproved, inferior quality cane varieties affect sugarcane production negatively as situation prevails to day (Mian, 2006). The solution of low cane yield and sugar recovery problem lies in the planting of improved cane varieties (Chattha *et al.*, 2006). Efforts are being made to increase cane production by introducing high yielding varieties and adoption of improved crop production techniques (Gill, 1995).

Success of variety depends upon its adaptability to agro-climatic conditions of the area. Selection of a proper variety to be sown in a particular agro-ecological zone is a primary requisite to explore its yield and sugar recovery potential. Ratoons are important for overall profitability of sugarcane cultivation as they save about 30% in the operational cost, mainly that of seed and reduced expenses for soil management (Sundara, *et al*., 1992). The inherent potential of a variety to give better yields in plant and ratoon crops is of paramount importance for sustaining high productivity. Acceptance of a variety by the farmers now depends very much on its ratooning potential. Thus, sugarcane varieties, which show good performance in plant and ratoon crops should be promoted for commercial cultivation.

The candidate sugarcane varieties developed by sugarcane research institutes and provincial cooperative units of the PARC, are regularly tested through National Uniform Varietal Yield Trials Program, conducted under agro-ecological regions of the country through coordinated Research Program of PARC. The rationing performance of candidate varieties was also evaluated (Jamil *et al.,* 2006). The objective of the present study is to evaluate the cane yield and quality performance of some new candidate sugarcane varieties in National Uniform Varietal Yield Trials under agro-climatic conditions of Thatta.

## MATERIALS AND METHODS

During 2001-02 and 2002-03 crop seasons performance of eleven promising candidate sugarcane varieties obtained from different Sugarcane Research Institutes of Pakistan along with local check Thatta-10 was tested at National Sugar Crops Research Institute, farm Thatta. The varieties included were NSG-60 and NGS-555 from Shakarganj Sugar Research Institute, Jhang, AEC-86-347 from Nuclear Institute of Agriculture, Tandojam, S 96-SF-571, S 96-SF-574 and S

97-US-183 from Sugarcane Research Institute, Faisalabad, HS-4 and HS-12 from Habib Sugar Mills, Nawab Shah, S 87-US-1873 and S 88-US-436 from Sugarcane Research Institute, Mardan and Thatta-34 from National Sugar Crops Research Institute, Thatta.

The experiments were laid out following randomized complete block design with three replications. Plot size comprised seven meters long three rows with one-meter row to row space. Planting was done during October 2001-02 and 2002-03. The fresh crop was harvested during December p2003 and kept as ratoon crop for the next growing season, 2003-04. In the planted crops, NPK fertilizer dose @ 250:125:150 kg per hectare was applied as, one third nitrogen with full dose of phosphorus and potassium at the time of sowing; the remaining nitrogen was applied in two splits, one in February and the other in June. In ratoon crop about 25% more fertilizer than recommended dose was applied. All agronomic, insect pest and disease control measures were adopted uniformly throughout the growing season. The data for different parameters such as cane thickness, number of internodes per plant, cane height, millable canes per hectare and cane yield were recorded at harvest on plot basis and then converted into hectares. Five canes were randomly selected from the bulk produced in each plot for juice analysis. The canes were crushed in the crusher and their juice was analyzed in the laboratory for the assessment of commercial cane sugar percentage (CCS%) by Australian commercial cane sugar (CCS) formula given by Meade and Chen (1977) as:

$$CCS\% = \frac{3P}{2}\left(1-\frac{F+5}{100}\right)-\frac{B}{2}\left(1-\frac{F+3}{100}\right)$$

Where P is the Pol percentage of the first expressed juice, B is brix percentage of the first expressed juice and F is the fiber percentage in the cane.

The data recorded were statistically analyzed through MSTATC, Micro computer statistical programme, Michigan State University (1991).

## RESULTS AND DISCUSSION

The results of the study for plant crop during 2001-02 crop season revealed that there were significant differences in the mean values for cane yield and yield components (Table-1). Maximum average cane thickness (24.91 mm) was exhibited in variety NSG-555 followed by S 96-SP-571, NSG-60, S 97-US-183 and (23.78, 23.77, 23.67 and 23.55 Thatta-34 mm, respectively, against the check variety Thatta-10 (22.57 mm), while, minimum average cane thickness (21.75 mm) was recorded in S 88-US-436. The results revealed that the variety Thatta-34 remained on top with 22.66 internodes per plant followed by S96-SP-571, AEC 86-347, S 97-US-183, NSG-555 and S 96-SP-574 with 21.50, 20.58, 20.42, 20.33 and 20.08 internodes per plant, respectively, against the check variety Thatta-10 (18.83 internodes). In case of average cane height, the varieties S 97-US-183 and check variety Thatta-10 was on top with taller canes of 237.80 and 234.90 cm length, respectively; followed by AEC 86-347 (233.90 cm). Moreover, the varieties S 96-SP-571 and Thatta-34 produced at par results of 220.80 cm average cane height but like other varieties in the trial could not exceed the check variety (Table-1). Maximum (135.00) thousand millable canes per hectare were exhibited in variety Thatta-34 against check variety Thatta-10 (128.75 thousand millable canes per hectare). While, the varieties S 97-US-183, HS-12, HS-4, NSG-60, AEC 86-347 and S 87-US-1873 produced 116.25, 113.75, 112.50, 111.25, 106.25 and 101.25 thousands millable canes per hectare, respectively; but could not surpass the check variety in terms of this trait. The varieties S 88-US-436 and NSG-555 resulted into lowest 82.50 and 87.50 thousand millable canes per hectare, respectively. The variety Thatta-34 remained on top with maximum average cane yield (106.7 t $ha^{-1}$) against the check variety Thatta-10 (86.88 t $ha^{-1}$). However, the varieties AEC 86-347, S 97-US-183, S 96-SP-574, HS-12 and S 96-SP-571 produced good performance with average cane yield of 83.13, 81.88, 79.38, 73.00 and 70.63 t $ha^{-1}$, respectively; but did not out yield the check variety. In contrast to this, the varieties S 88-US-436, HS-4 and NSG-60 produced lowest average cane yield of 46.88, 55.00 and 55.63 t $ha^{-1}$, respectively. Maximum CCS (11.65%) was obtained from check variety Thatta-10. While, the varieties AEC 86-347, HS-12, Thatta-34, NSG-60 and NSG-555 produced CCS of 11.59, 11.42, 11.4011.35 and 11.31%, respectively; and remained almost equal to check variety. However, the minimum CCS of 10.48, 10.74 and 10.79% was recorded from HS-4, S 88-US-436 and S 96-SP-571, respectively.

All the varieties during 2002-03 crop season exhibited good performance in terms of average cane yield, yield components and CCS% as compared to previous year's plant crop (Table-2). The higher cane yield and sugar content in the varieties might be due to the heavy bearing tendency of these varieties and their adoptability to the climatic conditions of the Thatta. In addition to that, the inherent genetic make up of a variety might have contributed towards higher and lower cane yield and sugar content in both the plant crops. Genetically improved varieties may bear ability to produce satisfactory results for per hectare yield and sugar percentage under given set of environmental conditions. EL-Geddway, *et al.* (2002) stated that sugarcane varieties are greatly affected by genetic make up. According to Keerio *et al,* (2003) unless the genetic potentialities of a variety are high, mere provisions of growing conditions such as manuring, irrigation etc. will not lead to appreciable improvement in cane or sugar yield.

The average results of the plant crops for 2001-02 and 2002-03 crop seasons revealed that none of the varieties in the trial could go beyond the check variety in terms of average cane yield and CCS%. It is evident from the two year's plant crop data that the varieties having thicker plants, larger cane height with sufficient millable canes produced higher yields during both years of planting, while the varieties with lowest yield contributing traits resulted into reduced yield. Khan *et al,* (2003) reported that increase in cane yield might be due to maximum plant height, weight per stool and cane girth. Nazir *et al.* (1997) reported that higher cane yield is the function of high potential variety. Javed *et al.* (2001) reported that cane yield tones per hectare depend upon number of stalks per hectare and weight per stalk. Weight per stalk consequently depends upon stalk length and stalk girth. Sharma and Agarwal (1985) suggested that good germination and tillering with synchronized millable canes of average thickness are desired selection parameters to evaluate the agronomic performance of sugarcane varieties. Habib, *et al*. (1991) stated that number of millable stalks per plot and stalk diameter are most important components of cane yield.

**Table-1.Cane yield, yield components and quality data of different sugarcane varieties in National Uniform Varietal Yield Trial 2001-2002 at NSCRI, farm Thatta**

| Variety | Cane thickness (mm) | No. of internodes plant$^{-1}$ | Cane height (cm) | Millable canes (000 ha$^{-1}$) | Cane yield (t ha$^{-1}$) | CCS% |
|---|---|---|---|---|---|---|
| AEC 86-347 | 22.67 bc | 20.58 | 233.90 d | 106.25 e | 83.13 b | 11.59 |
| HS-4 | 22.60 bc | 17.58 | 196.80 f | 112.50 d | 55.00 cd | 10.48 |
| HS-12 | 22.47 bc | 18.24 | 199.20 g | 113.75 d | 73.00 bc | 11.42 |
| NSG-60 | 23.77 b | 18.58 | 185.80 h | 111.25 d | 55.63 c | 11.35 |
| NSG-555 | 24.91 a | 20.33 | 199.00 g | 87.50 g | 63.13 c | 11.31 |
| S 87-US-1873 | 22.68 bc | 18.75 | 198.00 e | 101.25 f | 68.25 bc | 11.12 |
| S 88-US-436 | 21.75 c | 18.41 | 211.80 f | 82.50 h | 46.88 d | 10.74 |
| S 96-SP-571 | 23.78 b | 21.50 | 220.80 e | 100.00 f | 70.63 bc | 10.79 |
| S 96-SP-574 | 23.30 b | 20.08 | 251.20 a | 100.00 f | 79.38 b | 11.04 |
| S 97-US-183 | 23.67 b | 20.42 | 237.80 b | 116.25 c | 81.88 b | 11.02 |
| Thatta-34 | 23.55 b | 22.66 | 220.80 e | 135.00 a | 106.7 a | 11.40 |
| Thatta-10 | 22.57 bc | 18.83 | 234.90 c | 128.75 b | 86.88 b | 11.65 |
| CV% | 9.34 | 14.48 | 12.48 | 22.83 | 26.97 | - |
| LSD 5% | 0.86 | NS | 0.97 | 1.94 | 7.72 | - |

Means followed by the same letter do not differ significantly at 5% level of probability

**Table-2.Cane yield, yield components and quality data of different sugarcane varieties in National Uniform Varietal Yield Trial 2002-2003 at NSCRI, farm Thatta**

| Variety | Cane thickness (mm) | No. of internodes plant$^{-1}$ | Cane height (cm) | Millable canes (000 ha$^{-1}$) | Cane yield (t ha$^{-1}$) | CCS% |
|---|---|---|---|---|---|---|
| AEC 86-347 | 24.53 b | 26.43 ab | 252.00 b | 158.33 a | 103.33 ab | 13.77 |
| HS-4 | 26.13 a | 20.40 bc | 223.20 c | 96.66 c | 74.00 b | 11.96 |
| HS-12 | 25.26 ab | 21.16 bc | 271.06 a | 138.33 ab | 117.33 a | 13.61 |
| NSG-60 | 24.02bc | 23.10 b | 220.96 c | 188.33 a | 126.66 a | 11.08 |
| NSG-555 | 26.91 a | 26.40 ab | 291.63 a | 121.66 ab | 109.66 a | 13.87 |
| S 87-US-1873 | 24.34 bc | 21.53 bc | 268.73 a | 110.00 bc | 85.83 b | 13.70 |
| S 88-US-436 | 22.47 c | 23.40 b | 216.10 c | 135.00 ab | 70.00 b | 11.25 |
| S 96-SP-571 | 24.62 b | 27.20 a | 222.06 c | 123.33 ab | 100.00 b | 11.42 |
| S 96-SP-574 | 25.30 ab | 27.73 a | 214.20 c | 123.33 ab | 89.16 b | 12.62 |
| S 97-US-183 | 23.92 bc | 23.16 b | 260.73 ab | 153.33 a | 126.66 a | 12.10 |
| Thatta-34 | 24.28 bc | 20.30 bc | 263.96 a | 130.00 ab | 111.66 a | 12.10 |
| Thatta-10 | 26.20 a | 27.20 a | 278.06 a | 146.66 ab | 146.66 a | 13.83 |
| CV% | 4.88 | 9.10 | 6.73 | 16.13 | 25.59 | - |
| LSD 5% | 2.05 | 3.69 | 28.36 | 36.99 | 45.53 | - |

Means followed by the same letter do not differ significantly at 5% level of probability

**Table-3.Average data of the plant crops in National Uniform Varietal Yield Trials for the years 2001-02 and 2002-03 at NSCRI, farm Thatta**

| Variety | Cane thickness (mm) | No. of internodes plant$^{-1}$ | Cane height (cm) | Millable canes (000 ha$^{-1}$) | Cane yield (t ha$^{-1}$) | CCS% |
|---|---|---|---|---|---|---|
| AEC 86-347 | 23.60 | 23.50 | 242.95 | 132.29 | 93.23 | 12.68 |
| HS-4 | 24.36 | 18.99 | 210.00 | 104.58 | 64.50 | 11.22 |
| HS-12 | 25.26 | 19.70 | 235.13 | 126.04 | 95.16 | 12.53 |
| NSG-60 | 24.02 | 20.84 | 203.38 | 149.79 | 91.14 | 11.21 |
| NSG-555 | 26.91 | 23.36 | 245.31 | 104.58 | 86.39 | 12.59 |
| S 87-US-1873 | 24.34 | 20.14 | 233.36 | 105.62 | 77.04 | 12.41 |
| S 88-US-436 | 22.47 | 20.90 | 213.95 | 108.75 | 58.44 | 10.99 |
| S 96-SP-571 | 24.62 | 24.35 | 221.43 | 111.66 | 85.31 | 11.10 |
| S 96-SP-574 | 25.30 | 23.90 | 232.70 | 111.66 | 84.27 | 11.83 |
| S 97-US-183 | 23.92 | 21.79 | 249.26 | 134.79 | 104.27 | 11.56 |
| Thatta-34 | 24.28 | 21.48 | 242.38 | 132.50 | 109.18 | 11.75 |
| Thatta-10 | 26.20 | 23.01 | 256.48 | 137.70 | 116.77 | 12.74 |

**Table-4.Cane yield, yield components and quality data of different sugarcane varieties in National Uniform Varietal Yield Trial 2003-2004 (Ratoon crop) at NSCRI, farm Thatta.**

| Variety | Cane thickness (mm) | No. of internodes plant$^{-1}$ | Cane height (cm) | Millable canes (000 ha$^{-1}$) | Cane yield (t ha$^{-1}$) | CCS% |
|---|---|---|---|---|---|---|
| AEC 86-347 | 20.80 f | 26.00 ab | 207.26 a | 81.73 e | 81.66 e | 12.78 |
| HS-4 | 21.46 e | 19.00 d | 176.40 c | 84.33 d | 75.20 f | 10.96 |
| HS-12 | 20.23 g | 21.33 | 187.00 bc | 99.86 c | 87.23 d | 12.87 |
| NSG-60 | 21.36 e | 20.66 cd | 180.66 c | 100.60 bc | 92.20 c | 12.41 |
| NSG-555 | 23.00 c | 24.66 b | 205.33 a | 82.06 de | 91.43 c | 12.91 |
| S 87-US-1873 | 21.40 e | 26.66 a | 188.26 bc | 95.93 cd | 86.86 d | 12.44 |
| S 88-US-436 | 20.70 f | 20.00 d | 184.30 bc | 94.46 cd | 93.47 c | 11.47 |
| S 96-SP-571 | 22.30 d | 23.66 b | 194.00 b | 85.33 d | 89.46 cd | 11.29 |
| S 96-SP-574 | 23.53 b | 22.33 c | 190.36 b | 80.50 e | 83.03 e | 12.55 |
| S 97-US-183 | 20.36 f | 23.66 b | 205.20 a | 95.63 cd | 92.00 c | 12.36 |
| Thatta-34 | 23.00 c | 27.66 a | 206.56 a | 103.50 b | 101.86 b | 12.40 |
| Thatta-10 | 25.30 a | 27.00 a | 208.13 a | 109.86 a | 110.33 a | 12.93 |
| CV% | 4.45 | 11.37 | 4.53 | 6.96 | 5.46 | - |
| LSD 5% | 0.47 | 1.31 | 4.30 | 3.15 | 2.41 | - |

Means followed by the same letter do not differ significantly at 5% level of probability

The results of study regarding succeeding ratoon crop during 2003-04 crop season revealed that the check variety Thatta-10 displayed good performance in terms of average cane yield and CCS% as compared to other varieties (Table-4). A cane yield decline of 10-15% in ratoons is a common phenomenon throughout the world (Sundara *et al.,* 1992). Variation among sugarcane varieties in respect of ratoon cane yield has also been reported by Raman *et al.* (1985), Milligan *et al.* (1990), Bahadar *et al*. (2001) and Jamil *et al.* (2007).

**Conclusion:** It was observed that none of the varieties in plant and ratoon crop of the trials could surpass the check variety Thatta-10 in terms of average cane yield and CCS%. However, the varieties Thatta-34, NSG-60 and NSG-555 exhibited better performance for cane yield but showed satisfactory performance for CCS% and thus, were identified as good yielding varieties. While, AEC 86-347, NSG-555, HS-12 came out to be the good sugar content varieties due to their better performance for CCS% and satisfactory performance for cane yield. The potential of AEC-86-347, Thatta-34, NSG-60, NSG-555 and HS-12 need to be tested for some more years under agro-climatic conditions of Thatta to draw out substantial conclusions.

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