

CANE YIELD AND QUALITY APPRAISAL OF THATTA-2109 SUGARCANE VARIETY IN DIFFERENT VARIETAL TESTING TRIALS IN SINDH

*Naimatullah Bughio, *Riaz Noor Panhwar, *Muhammad Chohan, *Salahuddin Junejo
and *Ghulam Sarwar Unar

*National Sugar and Tropical Horticulture Research Institute (NSTHRI), PARC, Thatta

ABSTRACT

Sugarcane variety Thatta-2109 was developed from exotic fuzz of USA origin by the scientists of National Sugar and Tropical Horticulture Research Institute (NSTHRI), PARC, Thatta. The variety was extensively tested in different variety evaluation and selection trials at NSTHRI, Thatta and farmer fields in Sindh. The average results of all experiments in plant and ratoon crop at different locations confirmed its superiority over standard sugarcane varieties commercial in Sindh. The average results of experiments revealed that sugarcane variety Thatta-2109 exhibited maximum average cane yield of 113.0 t/ha against the standard sugarcane varieties CPF-237, SPF-234 and Thatta-10 which produced an average cane yield of 105.03, 103.40 and 108.52 t ha⁻¹, respectively. In case of quality, Thatta-2109 also remained better by producing CCS of 14.78% against the standard varieties CPF-237, SPF-234 and Thatta-10 which produced CCS of 13.86, 14.09 and 14.0%, respectively. Thus, on account of its best performance, in terms of average cane yield and CCS%, in plant and ratoon crops as compared to standard sugarcane varieties it is suggested that the potential of this approved sugarcane variety should be utilized commercially on the farmer fields for enhancing cane and sugar productivity in the country.

INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) belongs to family Gramineae and is a complex hybrid of five different species of the genus *Saccharum*. There are two main groups within the genus; the thin, hardy types like the north Indian *S. barberi* (2n = 81 to 124) and the Chinese *S. sinense* (2n = 111 to 120) and the thick, juicy noble canes like *S. officinarum* (2n = 80). *S. robustum* (2n = 60 to 80) is the closest wild relative and putative ancestor of *S. officinarum*. It is supposed that the origin of *S. officinarum* is the Indo-Myanmar-Chinese border. However, New Guinea is the main centre of diversity today

(Khalid *et al.*, 2016). Sugar and its by-products like ethanol, molasses, bagasse, press mud and wax, etc. are obtained from this non-cereal grass which is grown on large scale in tropical and subtropical regions of the world. In recent times, it has gained main emphasis as a second generation energy crop for cellulosic ethanol due to its high biomass (Pinto *et al.*, 2010; Suman *et al.*, 2011). It is an important cash crop of Pakistan, mainly grown for sugar and sugar-related products like *Gur* and *Shakr* and its by-products are used as fodder, in chipboard and paper industries (Memon *et al.*, 2010).

Pakistan is placed at the fifth position in its acreage and production and 15th position in sugar production in the world (Memon *et al.*, 2010). The sugar industry is now providing an important support to economic development in Pakistan; it is also the main source of farmer income and employment. The very existence of this industry in Pakistan is totally dependent on sugarcane supply. Regardless of pronounced developments in sugarcane research and expansion in sugar industry, our national average sugarcane yield during last five years remained oscillated between 50-57 t h⁻¹ and sugar recovery 9-10% whereas, the potential

is between 150-250 t h⁻¹ with 11-12% sugar recovery at research stations and progressive grower farms.

Keeping in view the importance of sugarcane in the agricultural industry, massive efforts are being made for the development of this crop for sustainable and better agronomic traits (Nawaz *et al.*, 2013). Recommended sugarcane varieties are taking major part in up scaling the cane productivity. Sugarcane breeders at different public and private sector in Pakistan are working on development of high yielding, more sugar containing, insect pest and disease resistant varieties (Khalid *et al.*, 2016). In Pakistan, new varieties of sugarcane are generally developed through selection (Shahzad *et al.*, 2016). The same selection method is also being followed at National Sugar and Tropical Horticulture Research Institute (NSTHRI), PARC, Thatta Sugarcane crop, however, is presently exposed to severe crisis in the country. Both farming community and industry are making hard for its sustainable growth. The main challenges confronting to this crop are lower average production per unit area and low sugar recovery (Arain *et al.*, 2011). The low cane yield and sugar recovery in Pakistan may be due to the fact that most of the sugarcane varieties under commercial cultivation are getting outdated and losing their potential with the passage of time (Junejo *et*

al., 2012). The pace of work on the development and release of new sugarcane varieties is very slow in the country. There are few sugarcane varieties, i.e Thatta-10, CPF-240, CPF-234, SPF-237, HS-12, NIA-2004, NIA-2012 and LRK-2004 under commercial cultivation in Sindh. With the passage of time, said varieties will get obsolete and may lose their production potential due to admixture and susceptibility to biotic and abiotic stresses. The farmers in Sindh have limited options to cultivate sugarcane varieties for higher economic returns under particular agro-climatic conditions. Therefore, it is imperative to include new improved sugarcane varieties time and again to augment gene pool, so that the growers may have a choice for variance in their sugarcane crops with new sugarcane varieties.

The scientists of National Sugar and Tropical Horticulture Research Institute (NSTHRI), PARC, Thatta are putting their best efforts in sugarcane variety development research. After years of research the scientists of NSTHRI succeed to develop a new sugarcane variety Thatta-2109. The said variety is early maturing with high cane and sugar recovery potential, good ratooner, having good germination ability, fast growth habit in all growth stages, good tillering ability, semi self trashed, thicker cane stalks with no lodging, resistant to root, stem and top borers as well as resistant to smut, rust and

red rot diseases. The variety Thatta-2109 has been approved by Provincial Seed Council, Sindh for commercial cultivation on farmer fields. Sugarcane being the second important cash crop which exerts a great impact on the betterment of sugarcane growers as it contributes a major proportion of their derived income from agriculture (Hassan *et al.*, 2017). Therefore, keeping in view the importance of sugarcane crop in Pakistan's agriculture and industry, present study was conducted to evaluate the performance of Thatta-2019 sugarcane variety in plant and ratoon crops.

MATERIALS AND METHOD

The exotic fuzz (true seed) of varying bi-parental crosses was received from Sugarcane Research Institute, Hoama, Louisiana, USA. The fuzz was grown in nursery at National Sugar and Tropical Horticulture Research Institute (NSTHRI), PARC, Makli Thatta for seedling clones development. A large numbers of seedling clones were developed and shifted to main field at NSTHRI experimental farm for year-wise testing in different selection stages. The number of clones in each selection stage was reduced by rejecting undesirable clones, while the clones carrying genetically superior traits were promoted to next selection stage for further evaluation and selection. The clone HoTh-2109 was evaluated against standard variety Thatta-10 in different

variety evaluation and selection trials at NSTHRI, farm, Thatta from 1998 to 1999 in single plant trial; from 1999 to 2002 in non-replicated trials, i.e. first cycle, second cycle and third cycle and from 2002 to 2005 in replicated trials, i.e. 4th cycle, preliminary yield and advanced varietal trial. After extensive evaluation in different variety evaluation trials at NSTHRI, PARC, Thatta, the performance of Thatta-2109 was also tested in zonal varietal testing trials at different locations of Sindh against Thatta-10 and other commercial sugarcane varieties from 2004 to 2011. After years of screening in different research experiments the variety Thatta-2109 was selected on the basis of high cane and sugar yield, almost resistant to insect pest and some prevailing diseases. The variety alpha numerical number was assigned as HoTh-2109, "Ho" stands for Hoama and "Th" stands for Thatta. Thatta-2109 name for the variety was proposed for the convenience of the farmers.

RESULTS AND DISCUSSION

The sugarcane variety Thatta-2109 was widely tested in different variety evaluation and development trials for several years at NSTHRI, farm and farmer fields with the view to ascertain its cane yield and quality potential. The results of different experiments for the evaluation of said variety are presented as under. During 2008-09, the data of

the trial at NSTHRI, Thatta farm in Table-1 revealed that Thatta-2109 showed its superiority by producing 3.93, 6.09 and 7.48 percent more cane yield than the standard varieties. In case of quality, Thatta-2109 maintained its dominance by producing 9.66, 5.72 and 6.05 percent more CCS than the standard varieties. During 2009-10, sugarcane variety Thatta-2109 showed its superiority by producing 4.05, 5.55 and 3.44 percent more cane yield than the standard varieties. In case of quality, Thatta-2109 maintained its dominance by producing 9.0, 6.58 and 6.65 percent more CCS than the standard varieties at NSTHRI, Thatta farm (Table-2).

The data of the experiment at Sayed Ferozuddin Shah Agricultural farm, Matiari in Table-3 revealed that sugarcane variety Thatta-2109 gave encouraging performance with average cane yield of 117.89 t ha⁻¹ against the standard varieties CPF-237, SPF-234 and Thatta-10 which gave average cane yield of 110.78, 106.11 and 114.78 t ha⁻¹, respectively. In case of quality, Thatta-2109 maintained its superiority by producing CCS of 14.57% against the standard varieties CPF-237, SPF-234 and Thatta-10 which produced CCS of 14.19, 14.10 and 13.88%, respectively. The data of the experiment at Muhammad Hassan Solangi Agricultural farm, Thatta in Table-4 revealed that sugarcane variety Thatta-2109 showed better performance with average

cane yield of 119.44 t ha⁻¹ against the average cane yield 106.33, 113.44 and 118.44 t ha⁻¹ obtained from standard varieties CPF-237, SPF-234 and Thatta-10, respectively. In case of quality, Thatta-2109 showed maximum CCS of 14.71% against the standard varieties CPF-237, SPF-234 and Thatta-10 which produced CCS of 14.28, 14.26 and 14.17%, respectively.

The data of ratoon study during 2009-10 at NSTHRI farm, Thatta (Table-5) revealed that variety Thatta-2109 produced 8.89, 12.63 and 14.27 percent more cane yield than the standard varieties. In case of commercial cane sugar percentage, the candidate variety Thatta-2109 gave encouraging results i.e. 10.16, 6.46 and 6.80 percent more CCS than that of standard varieties. The data of ratoon study at NSTHRI, Thatta during 2010-11 (Table-6) revealed that the variety Thatta-2109 produced 6.37, 8.05 and 3.61 percent more cane yield than the standard varieties. In case of commercial cane sugar percentage, Thatta-2109 gave encouraging results with 8.84, 5.56 and 5.89 percent more CCS than that of standard varieties.

The data of the experiment at Sayed Ferozuddin Shah Agricultural farm, Matiari shown in Table-7 revealed that in ratoon crop sugarcane variety Thatta-2109 gave encouraging performance with average cane yield of 105.66 t ha⁻¹ against the

standard varieties CPF-237, SPF-234 and Thatta-10 which gave average cane yield of 100.88, 91.66 and 102.77 t ha⁻¹, respectively. In case of quality, Thatta-2109 maintained its superiority by producing CCS of 14.68% against the standard varieties CPF-237, SPF-234 and Thatta-10 which produced CCS of 14.31, 14.27 and 14.16%, respectively. The data of the experiment at Muhammad Hassan Solangi Agricultural farm, Thatta (Table-8) revealed that in ratoon crop sugarcane variety Thatta-2109 showed encouraging performance with average cane yield of 114.55 t ha⁻¹ against the standard varieties CPF-237, SPF-234 and Thatta-10 which gave average cane yield of 100.99, 104.44 and 116.11 t ha⁻¹, respectively. In case of quality, Thatta-2109 maintained its superiority by producing CCS of 14.90% against the standard varieties CPF-237, SPF-234 and Thatta-10 which produced CCS of 14.34, 14.40 and 14.24%, respectively.

Pooled data of all experiments in plant and ratoon crop at different locations in Fig-1 and 2 revealed that sugarcane variety remained on top by producing average cane yield of 113.0 t ha⁻¹ against the standard sugarcane varieties CPF-237, SPF-234 and Thatta-10 which produced average cane yield of 105.03, 103.40 and 108.52 t ha⁻¹, respectively. In case of quality, Thatta-2109 maintained its dominance by producing CCS of 14.78%

against the standard varieties CPF-237, SPF-234 and Thatta-10 which produced CCS of 13.86, 14.09 and 14.0%, respectively. Sugarcane variety Thatta-2109 exhibited better performance in terms of average cane yield and CCS % in plant and ratoon crops at different locations as compared to standard sugarcane varieties.

The variety has shown consistent high cane yield and sugar recovery potential in different varietal testing trials at Thatta and other locations of Sindh. The higher cane yield and sugar recovery in Thatta-2109 may be attributed to its genetic potential which was demonstrated under given crop management practices. The variety Thatta-2109 has efficiently utilized the existing soil and water resources for better cane and sugar yield which confirms its superiority over other standard sugarcane varieties. Hence, its exploitation in farmer fields and sugar mills will enhance sustainable cane and sugar production in Sindh.

CONCLUSION

On the basis of its performance, it passed through variety approval process of Provincial Seed Council, Sindh. It is concluded that the potential of this approved sugarcane variety should be utilized commercially on farmers field for the enhancement and sustainability of cane and sugar productivity in the country.

SUGGESTIONS

In Pakistan, the pace of work on the development and release of new sugarcane varieties is required to be accelerated through strengthening the existing sugarcane variety development facilities. The coastal areas in Thatta, Pakistan are endowed with some specific agro-climatic conditions, which stimulate flowering in many sugarcane varieties. This conducive natural climate for cane flowering is needed to be exploited for sugarcane cross breeding programme. The sugarcane varieties developed through cross breeding in the country will be compatible to our indigenous requirement which eventually will contribute in enhancing cane and sugar productivity in the country. Extension department and sugar mills should come forward to promote recommended sugarcane varieties possessing high cane and sugar recovery potential for commercial cultivation. The price regulation system of the country is faulty and unacceptable to sugarcane farming community. As a result, the farmers get little interest in taking advantage of potential cane yield and sugar recovery of existing commercial sugarcane varieties by adopting recommended farming practices, which eventually affect the national average cane yield and sugar recovery. In this regard, sound policies are needed to be formulated by government.

Table-1 Performance of sugarcane varieties at NSTHRI, Thatta during 2008-09

Variety	Cane thickness (mm)	Cane height (cm)	Millable canes (000 ha ⁻¹)	Cane yield (t ha ⁻¹)	CCS%
HoTh-326	26.20	221.50	131.11	114.00	13.88
HoTh-300	28.80	258.88	143.80	120.11	13.76
HoTh-127	23.90	220.55	118.78	110.00	14.62
Thatta-2109	27.97	207.77	127.85	112.88	14.70
CPF-237	25.67	227.22	130.07	108.44	13.28
SPF-234	27.27	214.77	110.98	106.00	13.85
Thatta-10	26.23	213.55	116.66	104.44	13.81
CV%	13.25	19.46	10.79	9.37	-
LSD-0.5%	11.52	NS	21.28	16.12	
LSD-0.1%	12.07		30.05	NS	

Table-2 Performance of sugarcane varieties at NSTHRI, Thatta during 2009-10

Variety	Cane thickness (mm)	Cane height (cm)	Millable canes (000 ha ⁻¹)	Cane yield (t ha ⁻¹)	CCS%
HoTh-326	26.08	278.10	129.28	127.77	13.95
HoTh-300	27.94	300.65	135.80	131.55	13.80
HoTh-127	25.07	267.00	113.57	122.44	14.87
Thatta-2109	28.70	271.66	126.40	126.11	14.89
CPF-237	25.58	261.11	111.60	121.00	13.55
SPF-234	27.81	263.77	110.50	119.11	13.91
Thatta-10	25.82	271.11	112.78	121.77	13.90
CV%	10.21	8.92	11.79	8.91	-
LSD-0.5%	4.30	23.17	15.63	12.12	
LSD-0.1%	6.14	26.04	18.85	15.33	

Table-3 Performance of sugarcane varieties at Sayed Ferozuddin Shah Agricultural farm, Matiari during 2010-11

Variety	Cane thickness (mm)	Cane height (cm)	Millable canes (000 ha ⁻¹)	Cane yield (t ha ⁻¹)	CCS%
HoTh-326	26.87	258.33	141.13	117.55	14.22
HoTh-300	29.50	295.88	153.87	123.44	13.90
HoTh-127	24.79	257.22	128.85	107.11	14.51
Thatta-2109	28.73	244.44	137.96	117.89	14.57
CPF-237	26.44	263.88	140.26	110.78	14.19
SPF-234	28.07	251.44	121.16	106.11	14.10
Thatta-10	26.91	250.22	126.78	114.78	13.88
CV%	5.38	10.23	12.84	13.28	-
LSD-0.5%	2.52	44.50	23.30	24.02	-
LSD-0.1%	4.07	57.80	31.48	33.29	

Table-4 Performance of sugarcane varieties in plant crop at Muhammad Hassan Solangi Agricultural farm, Thatta during 2010-11

Variety	Cane thickness (mm)	Cane height (cm)	Millable canes (000 ha ⁻¹)	Cane yield (t ha ⁻¹)	CCS%
HoTh-326	27.08	259.44	145.94	121.11	14.30
HoTh-300	29.60	300.99	152.47	124.89	14.19
HoTh-127	25.74	267.00	119.90	105.78	14.64
Thatta-2109	29.70	253.33	143.07	119.44	14.71
CPF-237	26.58	251.11	124.60	106.33	14.28
SPF-234	28.81	259.44	147.51	113.44	14.26
Thatta-10	26.82	264.44	138.92	118.44	14.17
CV%	10.25	17.30	11.30	14.10	-
LSD-0.5%	7.60	31.78	21.46	22.17	-
LSD-0.1%	10.78	44.80	32.70	27.15	

Table-5 Performance of sugarcane varieties in ratoon crop at NSTHRI, farm, Thatta during 2009-10

Variety	Cane thickness (mm)	Cane height (cm)	Millable canes (000 ha ⁻¹)	Cane yield (t ha ⁻¹)	CCS%
HoTh-326	25.11	186.22	119.83	96.89	13.91
HoTh-300	28.37	212.44	134.07	99.41	13.79
HoTh-127	23.91	181.66	111.14	88.44	14.77
Thatta-2109	27.33	174.55	120.81	95.00	14.86
CPF-237	25.87	182.22	113.22	86.55	13.35
SPF-234	26.38	168.00	102.29	83.00	13.90
Thatta-10	26.00	176.77	113.00	81.44	13.85
CV%	7.13	11.60	10.00	9.41	-
LSD-0.5%	4.85	31.55	15.22	7.30	-
LSD-0.1%	6.20	40.10	17.80	9.66	-

Table-6 Performance of sugarcane varieties in ratoon crop at NSTHRI, farm, Thatta during 2010-11

Variety	Cane thickness (mm)	Cane height (cm)	Millable canes (000 ha ⁻¹)	Cane yield (t ha ⁻¹)	CCS%
HoTh-326	24.39	152.44	120.66	115.31	14.12
HoTh-300	27.81	193.03	126.88	118.81	13.96
HoTh-127	24.31	142.66	106.07	107.22	14.90
Thatta-2109	27.13	139.33	121.25	112.50	14.93
CPF-237	25.76	134.33	102.19	105.33	13.61
SPF-234	28.03	136.11	106.25	103.44	14.10
Thatta-10	25.93	143.88	118.42	108.44	14.05
CV%	5.07	7.90	9.89	9.37	-
LSD-0.5%	3.12	NS	8.41	16.02	-
LSD-0.1%	5.14		10.10	19.29	

Table-7 Yield and quality performance of sugarcane varieties in ratoon crop at Sayed Ferozuddin Shah Agricultural farm, Matiari during 2011-12

Variety	Cane thickness (mm)	Cane height (cm)	Millable canes (000 ha ⁻¹)	Cane yield (t ha ⁻¹)	CCS%
HoTh-326	25.95	252.89	129.83	109.55	14.36
HoTh-300	29.04	279.11	144.07	110.07	14.21
HoTh-127	24.41	248.33	121.14	91.77	14.66
Thatta-2109	28.31	241.22	130.81	105.66	14.68
CPF-237	26.54	248.88	123.22	100.88	14.31
SPF-234	27.34	234.67	111.96	91.66	14.27
Thatta-10	26.69	243.44	123.00	102.77	14.16
CV%	7.25	5.90	12.65	10.03	-
LSD-0.5%	10.18	NS	8.14	13.14	
LSD-0.1%	14.20		11.26	15.20	

Table-8 Yield and quality performance of sugarcane varieties in ratoon crop at Muhammad Hassan Solangi Agricultural farm, Thatta during 2011-12

Variety	Cane thickness (mm)	Cane height (cm)	Millable canes (000 ha ⁻¹)	Cane yield (t ha ⁻¹)	CCS%
HoTh-326	25.39	252.55	140.78	118.33	14.46
HoTh-300	28.81	293.14	147.03	119.33	14.27
HoTh-127	25.31	242.66	122.21	106.44	14.81
Thatta-2109	28.13	239.33	148.03	114.55	14.90
CPF-237	26.76	234.44	121.88	100.99	14.34
SPF-234	29.03	236.11	126.29	104.44	14.40
Thatta-10	26.93	244.107	141.86	116.11	14.24
CV%	6.25	7.80	10.19	9.88	-
LSD-0.5%	7.31	5.44	12.35	7.05	-
LSD-0.1%	9.17	7.50	14.20	9.33	-

REFERENCES

- Arain, M. Y., R. N. Panhwar, N. Gujar, M. Chohan, M. A. Rajput, A. F. Soomro and S. Junejo 2011. Evaluation of new candidate sugarcane varieties for some qualitative and quantitative traits under Thatta agro-climatic conditions. *The J. Anim. & Plant Sci.*, 21:226-230.
- Junejo, S., R. N. Panhwar, B. R. Kazi, A. A. Junejo, U. A. Talpur, G. M. Kaloi and M. Zubair. 2012. Study of sugarcane germplasm varieties for flowering ability under agro-climatic conditions of Thatta. *The J. Animals & Plant. Sci.* 22:688-694.
- Khalid, M., Hidayat ur Rahman, Farhatullah, A. Rabbani, M. Tahir, A. Samad and D. A. Lightfoot. 2016. Genetic variations in field condition clonally replicated sugarcane (*Saccharum officinarum* L.) cultivars on the basis of morphological and quality traits. *Plant Gene and Trait*, 7:1-12.
- Nawaz. M., I. Ullah, N. Iqbal, M. Z. Iqbal and M. A. Javed. 2013. Improving *in vitro* leaf disk regeneration system of sugarcane (*Saccharum officinarum* L.) with concurrent shoot/root induction from somatic embryos. *Turk. J. Biol.* 37: 726-732.
- Pinto, L.R., A. A. F. Garcia, M. M. Pastina, L. H. M. Teixeira, J. A. Bressiani, E. C. Ulian, M. A. P. Bidoia and A. P. Souza. 2010. Analysis of genomic and functional RFLP derived markers associated with sucrose content, fiber and yield QTLs in a sugarcane (*Saccharum* spp.) commercial cross. *Euphytica* 172: 313-327.
- Memon, A., A. M. Khushk and U. Farooq. 2010. Adoption of sugarcane varieties in the sugarcane growing areas of Pakistan. *Pakistan J. Agric. Res.* 23:122-131.
- Shahzad, S., F. A. Khan, M. Z. Iqbal, I. Khaliq and N. Ahmed. 2016. Characterization of local and exotic sugarcane genotypes on the basis of morphological and quality related attributes. *Pak. J. Agri. Sci.*, 53: 121-128.
- Suman, A., K. Ali, J. Arro, A.S. Parco, C. A. Kimbeng and N. Baisakh. 2011. Molecular diversity among members of the *Saccharum* complex assessed using trap markers based on lignin-related genes. *Bioenergy Res.* 5: 197-205.
- Hassan, S., A. Bashir, I. Mehmood, M. R. Yaseen and M. Qasim. 2017. Comparative economics of fresh and ratoon sugarcane production across selected districts of central Punjab. *J Agric. Res.*, 55: 557-564.