**Cane Yield and Quality Studies of Newly Approved Sugarcane Variety Thatta-2109 Under Agro-climatic Conditions of Thatta**

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**ABSTRACT**

The sugarcane variety Thatta-2109 was developed from exotic fuzz (true seed) of Hoama, Louisiana, USA at National Sugar and Tropical Horticulture Research Institute, PARC, Thatta. Large numbers of seedling clones were developed from the fuzz; these seedlings clones were shifted to main field at NSTHRI, experimental farm for year wise testing in different selection stages viz. single plant trial, first cycle, second cycle, third cycle, fourth cycle, preliminary yield trial and advanced varietal trial. After years of screening in different research experiments the genotype HoTh-2109 (Thatta-2109) was selected on the basis of high cane and sugar yield, almost resistant to insect pest and some prevailing diseases. The overall average results of the experiments revealed that candidate sugarcane variety Thatta-2109 remained better with average cane yield of 119.046 t/ha as compared to check variety Thatta-10 which produced average cane yield of 118.96 t/ha. In case of commercial cane sugar percentage (CCS%) candidate sugarcane variety Thatta-2109 produced maximum average CCS of 14.31%, while check variety Thatta-10 produced average CCS of 13.29%. Thus it was concluded that Thatta-2109 can be a best commercial variety in future.

**INTRODUCTION**

Sugarcane (S*accharum officinarum,*L.) crop is an important industrial and cash crop in Pakistan. In Pakistan sugarcane is cultivated on about one million hectare; the average sugarcane production is about 67.5 million tones. About 60% of the sugarcane is grown in Punjab, 30% in Sindh and only 10% in NWFP. Our national average cane yield is 57.55 tones per hectares i.e. 57.75 tones per hectare in Punjab, 61.71 tones per hectare in Sindh and 45.68 tones per hectare in NWFP. The average recovery 9.85% is in Punjab, 10.21% in Sindh and 8.75% in NWFP and the national average is 9.90% (PSMA 2014-15). However, the situation in terms of cane yield and sugar recovery is fairly better in Sindh as compared to other provinces in Pakistan.

There are number of reasons for lower cane yield and sugar recovery in Pakistan 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.

It is established fact that cane varieties play distinct role in enhancing cane yields at farmer’s fields and sugar recovery at mills. The cultural operations just provide a suitable environment to trigger the inherent potential of cane varieties for better production. In Pakistan, the pace of work on the development and release of new sugarcane varieties is very slow. There are few sugarcane varieties 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 and all over Pakistan 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 in the existing varietal pool, so as 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, PARC Thatta, after years of screening and selection have evolved a new sugarcane variety Thatta-2109 (HoTh-2109), which combines the distinct characters of commercial worth. This newly approved sugarcane variety is a good addition in the existing pool of commercial varieties in Sindh and will benefit the farmers, millers and the state through maximum cane yield and quality production.

**MATERIALS AND METHOD**

The sugarcane variety Thatta-2109 was developed from exotic fuzz (true seed). The sugarcane fuzz of bi-parental crosses CP 87-1737 x CP 85-1491 and pedigree H 92-625/171 was received from Sugarcane Research Institute, Hoama, Louisiana, USA. The fuzz was grown in nursery at National Sugar and Tropical Horticulture Research Institute, PARC, Makli Thatta for seedling clones development. Large numbers of seedling clones were developed; these seedlings clones were shifted to main field at NSTHRI, experimental farm for year wise testing in different selection stages viz. single plant trial, first cycle, second cycle, third cycle, fourth cycle, preliminary yield trial and advanced varietal trial. The number of clones in each selection stage was reduced by rejecting undesirable clones, while the clones which were genetically superior in the traits of interest were promoted to next selection stage for further evaluation and selection. The variety number in all selection stages was originally 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. The clone HoTh-2109 was evaluated in different selection stages from 1998 2005. After years of screening in different research experiments the genotype HoTh-2109 (Thatta-2109) was selected on the basis of high cane and sugar yield, almost resistant to insect pest and some prevailing diseases. The selection sequence of Thatta-2109 is as under.

**SELECTION SEQUENCES OF THATTA-2109**

**Year** **Selection stage Clones/Genotypes Tested**

1998-1999 Single Plant Trial 5007

1999-2000 First Cycle 1631

2000-01 Second Cycle 113

2001-02 Third Cycle 132

2002-03 Fourth Cycle 10

2003-04 Preliminary Yield Trial 7

2004-05 Advanced Varietal Trial 9

The cane yield and quality studies of Thatta-2109 with standard variety Thatta-10 and other promising varieties were conducted in different varietal trials at experimental farm of National Sugar and Tropical Horticulture Research Institute, PARC Thatta for several years. The initial selection trials i.e. single plant trial, first cycle, second cycle and third cycle were comprised of non-replicated single/double rows. While, in fourth cycle, preliminary yield trial and advanced varietal trial the experiments were conducted under Randomized Complete Block Design (RCBD) with three and four replications. Recommended agronomic practices, fertilizer applications, insect pest and disease control measures were carried out throughout the growing season. On maturity data on cane yield, yield components and quality parameters were taken. The yield and quality data for candidate sugarcane variety Thatta-2109 in different experiments is discussed as under.

**(I) PERFORMANCE IN FOURTH CYCLE**

During 2002-03, performance of ten promising sugarcane lines developed by NSTHRI, Thatta along with standard varieties Thatta-10 and BL-4 as check was tested in 4th cycle at NSTHRI, experimental farm Thatta. The data in Table-1 revealed that candidate variety Thatta-2109 (HoTh-2109) produced average cane yield of 104.17 t/ha against the cane yield 117.50 and 122.50 recorded from standard varieties Thatta-10 and BL-4, respectively. In case of quality, the data in Table-2 revealed that candidate variety Thatta-2109 (HoTh-2109) surpassed all the genotypes in the trial by producing maximum mean CCS of 15.23%. Moreover, the standard varieties Thatta-10 and BL-4 produced mean CCS of 14.55 and 12.84%, respectively.

**(II) PERFORMANCE IN PRELIMINARY YIELD TRIAL**

During 2003-04, performance of seven promising sugarcane lines developed by NSTHRI, Thatta along Thatta-10 as check variety was tested in preliminary yield trial at NSTHRI, experimental farm Thatta. The data in Table-3 indicated that candidate variety Thatta-2109 (HoTh-2109) gave encouraging performance with cane yield of 132.24 t/ha against standard variety Thatta-10 which produced cane yield of 135.43 t/ha. Month wise quality analysis data in Table-4 indicated that candidate variety Thatta-2109 (HoTh-2109) produced mean CCS of 12.87% against check variety Thatta-10, which produced mean CCS of 11.40%. In terms of quality, candidate variety Thatta-2109 showed its superiority by showing 111.42 percent increase in CCS over standard variety Thatta-10.

**(III) PERFORMANCE IN ADVANCED VARIETAL TRIAL**

During 2005-06, performance of nine promising sugarcane lines developed by NSTHRI, Thatta along Thatta-10 as check variety was tested in advanced varietal at NSTHRI, experimental farm Thatta. The data of the experiment in Table-5 indicated that candidate variety Thatta-2109 (HoTh-2109) produced cane yield of 119.83 t/ha against the cane yield (115.66 t/ha) recorded from standard variety Thatta-10. As such, Thatta-2109 gave 3.48% increase in cane yield over standard variety. In case of quality, the data in Table-6 indicated that candidate variety Thatta-2109 (HoTh-2109) produced mean CCS of 13.89% against the standard variety Thatta-10 which produced mean CCS of 12.82%. As such, Thatta-2109 surpassed the Thatta-10 by producing 7.71% increase in CCS.

**(iv) PERFORMANCE IN CANDIDATE VARIETIES DEMONSTRATION TRIALS**

* **Experiment at NSTHRI, Thatta farm during 2008-09**

The data of the trial in Table-7 revealed that candidate variety Thatta-2109 (HoTh-2109) produced average cane yield of 112.88 t/ha against the average cane yield 108.44, 106.0 and 104.44 t/ha obtained from standard varieties CPF-237, SPF-234 and Thatta-10, respectively. In this trial, 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 (HoTh-2109) showed CCS of 14.70% as compared to CCS 13.28, 13.85 and 13.81% obtained from standard varieties CPF-237, SPF-234 and Thatta-10, respectively (Table-8). As such Thatta-2109 maintained its dominance by producing 9.66, 5.72 and 6.05 percent more CCS than the standard varieties.

* **Experiment at NSTHRI, Thatta farm during 2009-10**

The data of the trial in Table-8 revealed that candidate variety Thatta-2109 (HoTh-2109) produced average cane yield of 126.11t/ha against the average cane yield 121.0, 119.11 and 121.77 t/ha obtained from standard varieties CPF-237, SPF-234 and Thatta-10, respectively. In this trial, 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 (HoTh-2109) showed CCS of 14.89% as compared to CCS 13.55, 13.91 and 13.90% obtained from standard varieties CPF-237, SPF-234 and Thatta-10, respectively. As such Thatta-2109 maintained its dominance by producing 9.0, 6.58 and 6.65 percent more CCS than the standard varieties.

**(v) OVERALL AVERAGE OF THE EXPERIMENTS**

Overall average of the experiments revealed that candidate sugarcane variety Thatta-2109 remained better by producing average cane yield of 119.046 t/ha against the check variety Thatta-10 which produced average cane yield of 118.96 t/ha. In case of commercial cane sugar percentage (CCS%) candidate sugarcane variety Thatta-2109 showed it s superiority over check variety and produced maximum average CCS of 14.31%, while check variety Thatta-10 produced average CCS of 13.29%. Thus it was concluded that Thatta-2109 can be a best commercial variety in future.

**Table-1. Performance of different sugarcane genotypes in 4th cycle at NSTHRI, farm Thatta during 2002-03.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Genotypes | Cane thickness(mm) | Cane height(cm) | Number of internodes/Plant | Millable canes 000/ha | Cane Yield (t/ha) |
| HoTh-223 | 26.39 | 208.89 | 21.99 | 136.65 | 100.80 |
| HoTh-234 | 25.03 | 261.33 | 23.45 | 168.35 | 151.40 |
| HoTh-236 | 25.31 | 286.22 | 28.22 | 188.35 | 161.67 |
| HoTh-254 | 27.89 | 165.67 | 24.50 | 75.00 | 77.50 |
| HoTh-271 | 26.52 | 231.22 | 24.56 | 163.35 | 164.00 |
| HoTh-299 | 25.76 | 141.33 | 15.33 | 131.65 | 64.17 |
| HoTh-2100 | 22.78 | 203.22 | 19.22 | 195.00 | 110.00 |
| HoTh-2103 | 24.64 | 156.67 | 14.22 | 210.00 | 105.83 |
| HoTh-2109 | 26.33 | 202.56 | 19.22 | 115.00 | **104.17** |
| HoTh-2119 | 24.17 | 254.16 | 25.67 | 110.00 | 100.00 |
| Thatta-10 | 26.07 | 245.22 | 23.11 | 143.35 | **117.50** |
| CV%LSD 0.5%LSD 0.1% | 4.692.002.72 | 11.6742.1057.22 | 9.863.574.86 | 20.7952.4271.25 | 29.8475.5278.18 |

**Table-2. Quality performance of different sugarcane genotypes in 4th cycle at NSTHRI, farm Thatta during 2002-03.**

|  |  |  |
| --- | --- | --- |
| Genotypes | Month wise Commercial Cane Sugar Percent (CCS%) | Mean |
| October | November | December | January |
| HoTh-223 | 11.81 | 12.42 | 13.17 | 13.51 | 13.51 |
| HoTh-234 | 11.79 | 12.39 | 13.02 | 13.36 | 13.36 |
| HoTh-236 | 11.20 | 11.91 | 12.77 | 13.07 | 13.07 |
| HoTh-254 | 11.29 | 11.56 | 11.71 | 11.80 | 11.80 |
| HoTh-271 | 11.40 | 11.71 | 12.30 | 12.48 | 12.48 |
| HoTh-299 | 11.82 | 12.57 | 12.69 | 13.27 | 13.27 |
| HoTh-2100 | 11.31 | 12.00 | 12.51 | 12.73 | 12.73 |
| HoTh-2103 | 11.29 | 11.85 | 12.00 | 12.68 | 12.68 |
| HoTh-2109 | 12.87 | 13.68 | 14.99 | 15.23 | **15.23** |
| HoTh-2119 | 12.41 | 13.32 | 13.74 | 13.87 | 13.87 |
| Thatta-10 | 12.69 | 13.47 | 14.00 | 14.55 | **14.55** |

**Table-3. Performance of different sugarcane genotypes in preliminary yield trial at NSTHRI, farm Thatta during 2003-04.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Genotypes | Cane thickness(mm) | Cane height(cm) | Number of internodes/Plant | Millable canes 000/ha | Cane Yield (t/ha) |
| HoTh-236 | 24.31 | 210.34 | 20.21 | 80.60 | 155.70 |
| HoTh-254 | 22.83 | 260.73 | 21.99 | 82.50 | 115.50 |
| HoTh-311 | 24.45 | 235.55 | 23.70 | 128.30 | 134.34 |
| HoTh-326 | 25.94 | 300.73 | 25.40 | 180.60 | 155.70 |
| HoTh-329 | 23.28 | 261.39 | 20.33 | 75.00 | 70.00 |
| HoTh-2109 | 23.85 | 234.50 | 22.95 | 128.85 | **132.24** |
| HoTh-2119 | 23.06 | 187.88 | 20.45 | 77.25 | 70.00 |
| Thatta-10 | 25.26 | 304.37 | 25.60 | 128.30 | **135.43** |
| CV%LSD 0.5%LSD 0.1% | 1.53NS | 7.1023.2633.00 | 6.392.513.70 | 3.286.9210.64 | 2.495.307.12 |

**Table-4. Quality performance of different sugarcane genotypes in**

 **preliminary yield trial at NSTHRI, farm Thatta during 2003-04.**

|  |  |  |
| --- | --- | --- |
| Genotypes | Month wise Commercial Cane Sugar Percent (CCS%) | Mean |
| October | November | December |
| HoTh-236 | 10.25 | 10.75 | 11.26 | 11.08 |
| HoTh-254 | 10.83 | 11.26 | 11.59 | 11.22 |
| HoTh-311 | 12.74 | 12.85 | 12.90 | 12.83 |
| HoTh-326 | 12.75 | 12.78 | 12.85 | 12.79 |
| HoTh-329 | 11.04 | 11.17 | 11.64 | 11.28 |
| HoTh-2109 | 12.74 | 12.86 | 13.02 | **12.87** |
| HoTh-2119 | 10.73 | 11.10 | 11.58 | 11.13 |
| Thatta-10 | 11.13 | 11.39 | 11.68 | **11.40** |

**Table-5. Performance of different sugarcane genotypes in advanced varietal trial at NSTHRI, farm Thatta during 2005-06.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Genotypes | Cane thickness(mm) | Cane height(cm) | Number of internodes/Plant | Millable canes 000/ha | Cane Yield (t/ha) |
| HoTh-307 | 24.79 | 195.22 | 21.32 | 114.96 | 100.67 |
| HoTh-311 | 26.91 | 197.66 | 23.10 | 104.40 | 100.83 |
| HoTh-316 | 24.73 | 180.22 | 23.59 | 122.16 | 101.16 |
| HoTh-318 | 25.73 | 217.33 | 24.99 | 118.83 | 109.53 |
| HoTh-332 | 24.38 | 218.32 | 24.66 | 113.83 | 102.05 |
| HoTh-344 | 24.97 | 194.77 | 24.88 | 110.50 | 112.50 |
| HoTh-348 | 25.95 | 218.77 | 26.33 | 114.40 | 121.22 |
| HoTh-349 | 24.94 | 208.66 | 23.88 | 118.83 | 119.33 |
| HoTh-2109 | 27.09 | 185.77 | 21.66 | 111.60 | **119.83** |
| Thatta-10 | 26.82 | 211.66 | 22.88 | 118.83 | **115.66** |
| CV%LSD 0.5%LSD 0.1% | 3.551.532.10 | 10.7037.37- | 6.082.492.41 | 4.078.0110.98 | 4.979.4012.88 |

**Table-6. Quality performance of different sugarcane genotypes in advanced**

 **varietal trial at NSTHRI, farm Thatta during 2005-06.**

|  |  |  |
| --- | --- | --- |
| **Genotypes** | **Month wise Commercial Cane Sugar Percent (CCS%)** | **Mean** |
| **October** | **November** | **December** |
| HoTh-307 | 12.58 | 12.74 | 13.18 | 12.83 |
| HoTh-311 | 12.64 | 12.91 | 13.25 | 12.93 |
| HoTh-316 | 13.39 | 13.86 | 14.02 | 13.75 |
| HoTh-318 | 13.15 | 13.42 | 13.67 | 13.41 |
| HoTh-332 | 12.71 | 12.89 | 13.20 | 12.93 |
| HoTh-344 | 12.80 | 13.10 | 13.44 | 13.11 |
| HoTh-348 | 12.66 | 12.80 | 13.16 | 12.87 |
| HoTh-349 | 13.49 | 13.95 | 14.23 | 13.89 |
| **HoTh-2109** | 13.50 | 13.88 | 14.29 | **13.89** |
| **Thatta-10** | 12.69 | 12.70 | 13.08 | **12.82** |

Table-7. Performance of sugarcane varieties at NSTHRI, Thatta during 2008-09.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variety | Cane thickness (mm) | Cane height (cm) | Millable canes (000/ha) | Cane yield (t/ha) | 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 |
| HoTh-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%LSD-0.5%LSD-0.1% | 13.2511.5212.07 | 19.46NS | 10.7921.2830.05 | 9.3716.12NS |  |

Table-8. Performance of sugarcane varieties at NSTHRI, Thatta during 2009-10.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variety | Cane thickness (mm) | Cane height (cm) | Millable canes (000/ha) | Cane yield (t/ha) | 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 |
| HoTh-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%LSD-0.5%LSD-0.1% | 10.214.306.14 | 8.9223.1726.04 | 11.7915.6318.85 | 8.9112.1215.33 | - |