

NEW VARIETY / GENETIC STOCK

A climate resilient interspecific hybrid AS 04-1687 (IC 0636675: INGR 20110) tolerant to drought, waterlogging and salinity

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Development of climate resilient crop varieties with enhanced tolerance to heat, drought, salinity, excess water / flooding, chilling is essential in order to sustain and improve crop yields to manage the challenges of climate change (Maheshwari et al. 2015). Introgression of abiotic tolerant genes into climate resilient varieties depends upon the availability of potential sources from wild relatives and their exploitation. *Saccharum spontaneum* L. has been utilized in sugarcane breeding since 1912 due to its wider adaptability under biotic and abiotic conditions. The genetic stock AS 04-1687 having drought and waterlogging tolerance is an interspecific hybrid derived from a cross between sugarcane commercial cultivar (BO 102) and the wild species *S. spontaneum* (IND 84-337) having the cytotype $2n=56$ which was not used in the breeding programme earlier. The hybrid AS 04-1687 is characteristic with erect habit, purple coloured cylindrical internode and leaf sheath which is tight and glabrous with brown coloured dewlap and deltoid auricle (Fig.1).

Evaluation for drought and water logging tolerance

Twenty seven ISH/IGH hybrids with diverse genetic base were tested for tolerance to drought at four AICRP(S) centres and water logging at 3 centres located in both tropical (Padegaon and Anakapalle/ Kolhapur and Vuyyuru) and

subtropical (Karnal and Faridkot/ Pusa) regions along with 3 standards for each centre in replicated trials (Alpha design) during 2016-17 (Plant crop) and 2017-18 (Plant and ratoon crops). Drought was imposed by withdrawing irrigation between 60 and 150 days after planting and harvesting in plant and ratoon crops respectively. Water logging was imposed either under natural water logging or in water stagnated condition (minimum 15 cm) for 150-210 days after planting/harvesting. Data obtained at harvest from all the centers under both normal and drought/waterlogging conditions in two plant and one ratoon crops for the important traits viz., cane yield (t/ha), CCS yield (t/ha), juice sucrose %, single cane weight (kg), cane diameter, tillers mortality %, relative water content after drought and number of millable canes (NMC) ('000/ha) were considered for pooled analysis and percent changes due to drought and waterlogging were estimated.

Performance of AS 04-1687 under drought conditions

Among the entries evaluated, the clone AS 04-1687 exhibited the best performance with less than 20 % reduction for cane yield t/ha (18.5%), CCS t/ha (10.12%) and NMC ('000/ha) (13.0%) under drought condition while in the checks, reductions were 29.77%, 29.79% and 17.57% respectively for these three characters. The traits viz., cane diameter and relative water content after drought had shown least impact due to drought condition



Figure 1. Salient features of AS 04-1687

with 1.02% and 2.12% reductions respectively. In the checks 4.15% reduction for cane diameter and 4.31% reduction for relative water content

after drought were observed. Under drought condition, tillers mortality % was less in AS 04-1687 with 30.09% while it was higher with 39.84 in the checks (Table 1). Among the entries tested, the clone AS 04-1687 was identified as the best for drought tolerance.

Performance of AS 04-1687 under waterlogging conditions

Pooled analysis indicated that the clone AS 04-1687 exhibited low percent reduction for many traits after the waterlogging period. The clone showed 1.97%, 8.22% and 5.20% reduction for CCS t/ha, single cane weight (kg) and NMC (000³/ha) respectively while

Table 1. Performance of AS 04-1687 under drought conditions

Characters	AS 04 -1687			Checks***		
	Normal	Drought	% change	Normal	Drought	% change
Cane yield t/ha	116.15	94.66	-18.50	94.0	66.01	-29.77
CCS t/ha	8.79	7.9	-10.12	12.15	8.53	-29.79
NMC* (000 ³ /ha)	173.12	150.61	-13.00	83.8	69.07	-17.57
Cane Diameter	1.97	1.95	-1.02	2.65	2.54	-4.15
Tillers mortality %	33.45	30.09	-10.05	39.97	39.84	-0.32
RWC** after drought	78.43	76.77	-2.12	83.66	80.05	-4.31

* Number of millable canes (Thousands/ha); **RWC Relative water content; ***Mean of 9 checks viz., Co 92005, CoM 0265, Co 86032, CoV 94101, CoV 92102, CoV 09356, BO 91, BO154 and BO145 (Source: PICI – AICRP(S) annual report for the year 2016-17 and 2017-18)

Table 2. Performance of AS 04-1687 under waterlogging conditions

Characters	AS 04- 1687			Checks**		
	Normal	Water	%	Normal	Water	%
		logging	change		logging	change
Cane yield t/ha	90.86	75.94	-16.42	74.23	61.26	-17.47
CCS t/ha	8.14	7.98	-1.97	10.51	8.43	-19.79
Sucrose % at harvest	12.91	13.02	0.85	18.69	17.71	-5.24
Single Cane Weight (kg)	0.73	0.67	-8.22	1.05	0.84	-20.00
NMC (000'ha)*	108.84	103.18	-5.20	67.96	61.13	-10.05

* Number of millable canes (Thousands/ha); ** Mean of 12 checks viz., Co 86032, CoM 0265, CoM 88121, 83 R 23, CoA 06231, CoA 92081, Co 0238, BO 91, CoJ 88 (two locations), Co 98014 (two locations)
(Source: PICI – AICRP(S) annual report for the year 2016-17 and 2017-18)

checks recorded 5.24 % reduction. Considering the superior performance for the above traits, AS 04-1687 was considered as a better waterlogging tolerant clone.

Gene expression profile of AS 04-1687

In pot culture experiments it exhibited tolerance to drought and salinity. Candidate genes that are implicated in drought and salinity were used for the amplification of the hybrids AS-1687 along with drought and salinity tolerant clones of *S. spontaneum*. Analysis of the gene products/alleles in the clones indicated that AS 04-1687 related closely with IND 00-1039 (*S. spontaneum*) with 93.33 similarity and both clones were tolerant to

drought and salinity. In addition RT-PCR analysis revealed differential expression of key genes implicated in drought and salinity tolerance in AS 04-1687. This hybrid AS 04-1687 has been registered as genetic stock as INGR20110 (20177; IC0636675 INGR20110) with NBPGR, New Delhi.

Reference

Maheswari M, Sarkar B, Vanaja M., Srinivasa Rao, M, Srinivasa Rao Ch, Venkateswarlu B, Sikka AK. 2015. Climate Resilient Crop Varieties for Sustainable Food Production under Aberrant Weather Conditions. NICRA- Bulletin No.4