

**SHORT COMMUNICATION****Agronomic performance of rare hybrids with female restitution in interspecific crosses of commercial cultivar of sugarcane and *Saccharum spontaneum* L.**

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**Abstract**

High compatibility in interspecific crosses among species of *Saccharum* with peculiar chromosome transmissions in the progeny is well documented. It depends upon the species combination used in the interspecific crosses. Though  $2n + n$  transmission is common in *Saccharum officinarum* x *S. spontaneum*, which led to the success of the first man made interspecific commercial hybrid Co 205, it is an uncommon phenomenon with commercial cultivar x *S. spontaneum*. Recently,  $2n+n$  transmission with female restitution in two hybrids from the crosses of Co 89029 ( $2n=110$ ) x *S. spontaneum* ( $2n=88$ ) and Co 89029 ( $2n=110$ ) x *S. spontaneum* ( $2n=112$ ) has been identified. These hybrids, 04-2153 with  $2n=153$  and 04-244,  $2n=166$  were evaluated for their agronomic characters. Improvement over the female parent was observed for number of millable canes (74.3%), plant height (15.0 %), cane yield (7.37 %), dry matter production (67.14%), fibre (59.62 %) and pollen fertility (97.16 %) in the hybrid 04-2153 while the hybrid 04-244 had shown considerable improvement over the female parent for number of millable canes (49.85 %), cane yield (25.59 %), pollen fertility (46.83%), dry matter production (34.27) and fibre content (46.15%). Performance of these hybrids and their utilisation in commercial breeding programme are discussed.

**Keywords:** Female restitution;  $2n$  gametes; Hybrids; Improvement

Species of *Saccharum* are complex polyploids with diverse chromosome number. It includes four cultivated species with  $2n = 80$  (*S. officinarum* L.),  $2n = 82-124$  (*S. barberi* Jesw.),  $2n=111-118$  (*S. sinense* Roxb.),  $2n = 60-122$  (*S. edule* Hassk.) and two wild species with  $2n = 40 -128$  (*S. spontaneum* L.) and  $2n = 60 -148$  (*S. robustum* Brandes & Jesw. Ex Grassl.) (Sreenivasan 1987). Interspecific crosses are usually compatible among species of *Saccharum* (except *S. edule*) with peculiar chromosome transmissions in the progenies of certain *Saccharum* interspecific crosses (Bhat and Gill 1985). Several studies proved that  $2n + n$  transmission is common in the interspecific crosses of *S. officinarum* x *S. spontaneum* (Bremer 1949; Roach 1969; Nair

1975). This unique phenomenon of whole genome transmission from cultivated species led to the success of the first man made interspecific hybrid Co 205 which became commercially successful. Subsequently varieties were developed through one or two backcrosses involving these F1 hybrids and it significantly reduced the duration of varietal development. However, this female restitution is an uncommon in the crosses of commercial cultivar x *S. spontaneum* (Price 1961). Kandasamy (1961) noticed a rare hybrid with  $2n+n$  from a cross of POJ 2725 and *S. spontaneum* ( $2n=112$ ) with  $2n=161$ . In the present investigation,  $2n+n$  transmission with female restitution in two hybrids from the crosses of Co 89029 ( $2n=110$ ) x *S. spontaneum* ( $2n=88$ ) and Co 89029 ( $2n=110$ )

x *S. spontaneum* (2n = 112) has been identified (Suganya et al. 2019). These hybrids, 04-2153 with 2n=153 and 04-244, 2n=166 were evaluated for their agronomic performance and their merits are discussed.

Crosses were made between a commercial variety Co 89029 (female) and three cytotypes of *S. spontaneum* clones (males) with 2n=64, 2n=88 and 2n=112. For progeny performance studies, observations were recorded on NMC (number of millable canes), plant height, HR brix, cane thickness and internode length at 12<sup>th</sup> month in the ground nursery. In clonal evaluation, the two hybrids were identified with 2n + n transmission. It included 04-2153 with 2n=153

[Co 89029 (2n=110) x *S. spontaneum* (2n =88)] and 04-244 with 2n=166 [Co 89029 (2n=110) x *S. spontaneum* (2n = 112)]. The setts of the two hybrids with '2n' transmission viz., 04 - 244 and 04 - 2153 were planted in two rows of 20' length with three replication each along with the female parent (better parent - Co 89029) and economic biometric observations were recorded on NMC, plant height, HR brix, cane thickness, cane weight, cane yield, fibre content and above ground dry matter production at 12th Month and pollen fertility at the time of flowering. Fibre content estimated by the method described by Thangavelu (1982). Dry Matter production (DMP %) in cane was estimated gravimetrically. Five

**Table 1.** Mean performance of crosses involving Co 89029 and different cytotypes of *S. spontaneum*

Character	NMC*	Brix %	Height (cm)	Internode length (cm)	Thickness (cm)
Co 89029 (2n = 110) x <i>S. spontaneum</i> ( 2n = 64)					
PM**	23.7	11.2	239.6	14.7	1.0
Range	4.0 - 42.0	7.8 - 16.8	177.5 - 316.0	9.2 - 16.6	0.6 - 1.7
CV %	47.7	21.4	25.6	10.3	20.0
<i>S. spontaneum</i> ( 2n = 64 )	37.5	5.0	112.2	12.7	0.8
Co 89029 (2n = 110) x <i>S. spontaneum</i> ( 2n = 88)					
PM**	32.7	11.9	253.9	15.8	1.4
Range	2.0 - 60.0	5.0 - 16.2	145.6 - 305.2	8.3 - 25.0	0.7 - 2.1
CV %	38.5	18.4	11.2	21.5	21.4
<i>S. spontaneum</i> ( 2n = 88)	81.5	3.9	141.3	18.4	1.0
04-2153 (2n=153)	27.0	15.5	247.5	20.5	2.05
Co 89029 (2n = 110) x <i>S. spontaneum</i> ( 2n = 112)					
PM**	31.6	7.7	237.8	15.3	1.0
Range	3.0 - 58.0	4.4 - 16.3	162.4 - 350.8	12.5 - 21.0	0.5 - 2.0
CV %	54.9	44.16	26.4	21.7	33.6
<i>S. spontaneum</i> ( 2n = 112)	60.0	5.4	213.2	16.4	1.3
04-244 (2n=166)	23.0	15.8	220.5	16.0	1.95
Co 89029	64.6	20.8	210.8	13.3	2.1

\* Number of millable canes

\*\* Progeny mean

fully grown healthy canes including dry leaves and tops were cut from field at 11 months. The canes were shredded using mechanical fiberizing mill and mixed thoroughly for unbiased drawing of samples. Five hundred gram of the shredded canes was taken and dried in a hot air oven at 60°C for 2 days and 90°C for 2-4 days until the weight of the dry matter reached constant value. The final weight of the dry matter in cane was recorded and DMP % was worked out.

$$\text{DMP \%} = (\text{Final dry weight} \times 100) / \text{Initial fresh weight}$$

These hybrids were also tested for red rot disease under controlled condition testing (CCT) method with spore suspension of *Colletotrichum falcatum* pathotype of Co 94012 as described by Viswanathan et al. (1998).

Progeny performance studies indicated differential seed germination from different crosses with the different cytotypes used. The crosses, Co 89029 (2n = 110) x *S. spontaneum* (2n = 64) and Co 89029 (2n = 110) x *S. spontaneum* (2n = 88) produced 298 and 250 seedlings respectively. In

the cross, Co 89029 (2n = 110) x *S. spontaneum* (2n = 112), out of the 24 caryopses germinated only 11 seedlings survived in the field. Progeny mean for NMC was higher with the cytotypes 88 (32.7/seedling) and 112 (31.6/seedling) than the 64 cytotype (23.7 canes/seedling) derived progenies. The progeny mean for brix was lower (7.7%) with cytotype 112. The progenies with the cytotype 2n = 88 had taller and thicker canes with the progeny mean of 253.9 cm and 1.4 cm respectively. Variability was maximum with the cytotype 2n = 112 (Table 1).

**04-2153, 2n=153 [Co 89029, 2n=110 x *S. spontaneum*, 2n=88]**

The hybrid 04-2153 recorded NMC of 112.6/row, plant height - 263.0 cm; juice brix value - 15.5 per cent; cane thickness - 1.9 cm; pollen fertility - 90.1 per cent and cane yield - 113.7 kg/row. It had fibre of 24.9% and DMP of 35.6% and was resistant to red rot disease. Improvement over the female parent was observed for NMC (74.3%), plant height (15.0 %), cane yield (7.37 %), DMP (67.14%), fibre (59.62 %) and pollen fertility

**Table 2.** Performance of hybrids with '2n' transmission for various agronomic traits and its improvement

Clone	04 - 244 (2n = 166)		Co 89029	04 - 2153 (2n =153)	
	Mean	% of improvement	(2n = 110)	Mean	% of improvement
NMC/row	96.8	49.85	64.6	112.6	74.30
Plant height (cm)	210.6	-7.91	228.7	263.0	15.00
Cane thickness (cm)	2.0	-4.76	2.1	1.9	-9.52
Brix %	16.2	-23.58	21.2	15.5	-26.89
Pollen fertility (%)	67.1	46.83	45.7	90.1	97.16
Fibre %	22.8	46.15	15.6	24.9	59.62
Cane yield (kg/row)	133.0	25.59	105.9	113.7	7.37
DMP %	28.6	34.27	21.3	35.6	67.14
Cane wt (Kg)	0.87	-46.95	1.64	1.01	-38.41
Red rot reaction	R*		MR**	R*	

\*R-Resistant, \*\*MR- Moderately resistant

(97.16 %) (Table 2).

**04-244, 2n=166 [Co 89029, 2n=110 x *S. spontaneum*, 2n=112]**

This hybrid resembled the female parent especially for thick internodes. The hybrid recorded an average of 96.8 NMC, 210.6 cm of plant height, 2.0 cm of cane thickness. While the juice brix was 16.2 per cent the pollen fertility was 67.1 per cent. The hybrid also recorded a fibre % of 22.8, cane yield of 133.0 kg/row and total DMP of 28.6%. It was also resistant to red rot disease. This hybrid had shown considerable improvement over the female parent for NMC (49.85 %), cane yield (25.59 %), pollen fertility (46.83%), DMP (34.27%) and fibre content (46.15%) (Table 2).

In sugarcane breeding, several cytogenetical features of sugarcane are unearthed, the greater uncertainties with its breeding behaviour through meiotic abnormalities, differential functioning of gametes in fertilization, dosage of genes etc. (Raghavan 1953; Price 1961). Transmission of  $2n + n$  causes a rapid increase in chromosome number from the cultivated variety/species in  $F_1$  and  $BC_1$  generation when compared to that of  $n+n$  transmission (Bremer 1949). Interspecific hybrids are expected to be intermediate to their parents. In the present study, a greater proportion of chromosome of female parent resulted in the resemblance of hybrids with '2n' transmission towards their female parent (cane thickness, moderate brix) with the desired characters of *S. spontaneum* like NMC, fibre content, biomass due to  $2n+n$  transmission. Moderate juice brix, higher fibre content and increases biomass substantiated to use these clones as dual purpose energy cane directly so as to meet the emerging biofuel needs.  $2n + n$  transmission considered to be advantageous in obtaining varieties with commercial potential with less number of backcrosses (Roach 1977; Tai et al. 1992; Nair et al. 2017). Even though this '2n+n' transmission in the crosses with

commercial cultivars and *S. spontaneum* is a rare phenomenon, selection of hybrids with '2n' transmission from the female parent (commercial cultivar) is preferred to evolve varieties with the emerging needs.

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