

Development of Stress Tolerant, High Yielding and High Sucrose Content Sugarcane Variety

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ABSTRACT

Crop competition pushes sugarcane cultivation of Bangladesh in the marginal lands such as charlands, hilly areas, drought and salinity prone areas. In this context it is necessary to develop variety suitable for producing higher cane and sugar yield under condition of various stresses. The experiment was undertaken to develop and release a variety superior to existing variety in respect of yield and stress tolerance. To meet this target hybridization was done in 2005 between Isd 19 and Poj 2878 using as female and male parent respectively. Progeny of this cross was transplanted in the field and family selection was done in first year at F_1 generation. Next year from the family, individual clone was selected and clone number was given. Among the clones I 157-07 was found as better one and subsequently evaluated at preliminary yield trial, advance yield trial and zonal yield trial. In all these trials I 157-07 was found superior than the check variety. In 2015 the clone was evaluated at six locations by the field evaluation team of seed certification agency. Due to better agronomic characters, sugar and cane yield, field evaluation team suggested for releasing this clone as a variety. Average yield and pol% cane of the clone was 105.58 tha^{-1} and 13.93% respectively. Moreover, it showed highly tolerance to salinity, drought, flood and waterlogged stress condition. Considering better quality, the clone I 157-07 was finally released by the National Seed Board as a variety BSRIK 45 in 2016. Commercial cultivation of this variety will help the farmers to gain expected cane and sugar yield even under stress conditions.

Key words: BSRIK 45, stress tolerant, high yield, high sucrose

INTRODUCTION

Sugarcane has a long proud history as an industrial and cash crop. It is the main source of white sugar in Bangladesh as well as for the whole world. Recently, in Bangladesh this crop stands on a threshold of a potential revolution. Sugarcane breeding is widely acknowledged as the principal method for improving productivity in most cane research institute of the world. Breeding is also the principal method for sugarcane to combat with various stress condition by developing new varieties. Breeding can also have a significant effect on milling characteristics of cane including quality and quantity of sugar produced (James, 2004). It has long been observed that sugarcane varieties trend to 'run-out' or decline in yield after being grown for a few years in a particular area. To maintain high yields it has been necessary to replace varieties every few years with new clones. So, it requires a continuous flow of new varieties from the breeder in order to

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maintain tolerant and productive types in the fields. Due to introduction of various short duration crops in Bangladesh, sugarcane is being transferred to marginal lands day by day. Moreover, the farmers of southern part and Char lands in Bangladesh deserve some stress tolerant varieties which will be able to mitigate climatic change of the universe. The principal objectives of sugarcane breeding are yield; adaption to environmental adversities; disease-pest resistance; sugar content and quality. Keeping all these time befitting needs in mind, breeders of Bangladesh Sugarcrop Research Institute, conducted experiment for developing stress tolerant high yielding and high sucrose containing sugarcane variety. Hence BSRIKh 45, a new sugarcane variety has been developed and released to meet the farmer's demand especially in environmental stress prone areas of Bangladesh.

MATERIALS AND METHODS

Biparental cross was made after selecting different stress tolerant and high yielding parents at Breeding Division, Bangladesh Sugarcrop Research Institute, Ishurdi, Pabna in 2005. The variety BSRI Kh 45 is a progeny of a cross where released variety Isd 19 was used as female and an exotic genotype Poj 2878 as a male parent. F_1 seedlings from true seed were raised in the nursery and then transplanted to the field. Subsequent selections were done in Preliminary, Advanced and Zonal Yield Trails based on qualitative and quantitative traits. For finding out stress tolerant clones both artificial/induced stress condition and field-testing method was used. Five clones along with a standard variety Isd 39 were evaluated in zonal yield trial at seven locations namely Thakurgoan, Ishurdi, Rajshahi, Dorshona, Jamalpur, Joypurhat and Gazipur during 2014-15 cropping year. A randomized complete block design with three replications was followed at all the locations for the experiment. Each genotype was grown in six rows of ten meter long plot having one meter space between rows. At each location three buded setts were planted in the months of November 2014 and the crop was harvested during the last week of December in the following year. Normal cultural practices were done as per requirement. Data were recorded from middle four rows of each plot.

RESULTS AND DISCUSSION

Cane yield data of five clones over seven locations are furnished in Table1. From the data of Table1 it was cleared that the variety BSRIKh 45 was found significantly superior over all other genotypes including the standard variety Isd 39. It yielded 105.58 t ha^{-1} where as the standard Isd 39 was 86.84 t ha^{-1} . The yield of standard variety Isd 39 was statically similar with other clones. From the table it was observed that the yield of BSRIKh 45 was highest (130.14 t ha^{-1}) at Jamalpur location which was followed by Joypurhat location. Singh *et.al.* (1982) mentioned that higher yield was a good characteristic of a variety. The yield of BSRIKh 45 ranged from 80.05 to 130.14 t ha^{-1} where the standard variety ranged from 55.15 to 121.10 t ha^{-1} .

Table 1. Cane yield (tha⁻¹) at different locations in Zonal Yield Trial

Variety/ Clone	Ishurdi	Thakurgoan	Joypurhat	Rajshahi	Dorshona	Gazipur	Jamulpur	Mean
BSRI Akh 45	93.31	102.00	134.29	113.58	85.70	80.04	130.14	105.58 a
I 164-07	76.13	81.38	97.51	83.87	77.40	67.52	110.12	84.85 b
I 167-07	72.63	75.75	103.57	96.62	71.95	62.84	105.10	84.07 b
I 290-08	77.50	85.25	93.35	84.41	78.35	60.46	107.07	83.77 b
I 295-08	74.69	101.31	107.24	94.54	82.73	57.63	95.98	87.73 b
Isd 39	65.25	91.00	100.07	100.33	74.98	55.15	121.10	86.84 b
Lsd (0.05)								7.98
CV (%)								7.74

Chemical analyses in different months are presented in Table 2. It was observed that the pol% cane of BSRI Akh 45 was higher than the standard variety and other clones. Statistically it was similar with Isd 39. BSRI Akh 45 showed highest pol% cane (13.93). Pol % cane ranged from 11.84 in October to 15.39 in January. An increasing trend was observed in case of pol% cane from October to January.

Table 2. Monthly Pol% cane

Variety/Clone	Month				Mean
	October'15	November'15	December'15	January'16	
BSRI Akh 45	11.84	13.61	14.87	15.39	13.93 a
I 164-07	11.01	11.83	12.39	13.20	12.13 bc
I 167-07	11.58	12.47	13.27	12.79	12.53 b
I 290-08	10.19	11.35	12.07	13.07	11.67 c
I 295-08	11.60	11.55	12.17	13.18	12.12 bc
Isd 39	12.07	12.54	14.75	15.14	12.62 a
LSD (0.05)					0.67
CV (%)					5.35

Table 3. Performance of the genotypes under waterlog, flood, drought and salinity stress conditions

Variety/ clone	Waterlog	Flood	Drought	Salinity	Rating scale(1-5)**
BSRI Akh 45	1	1	1	1	** Tolerance rating scale (1-5) is based on greenness of plants and other data collected Where 1 = Highly Tolerant 2 = Tolerant 3 = Moderately Tolerant 4 = Intolerant 5 = Highly Intolerant
I 164-07	4	3	3	3	
I 167-07	3	3	3	3	
I 290-08	2	1	2	1	
I 295-08	2	1	2	1	
Isd 39	1	1	1	1	

The standard variety Isd 39 was used for its high tolerance to water-logged, flood, salinity and drought stress. Table 3 showed that BSRIK 45 was highly tolerant against flood, water-logged, drought and salinity stress conditions and stress tolerance potentiality of BSRIK 45 was similar with Isd 39. So, the clone can be cultivated in water-logged and field drought, salinity and flood prone areas of Bangladesh.

Table 4. Cane yield (tha^{-1}) of BSRIK 45 comparing with the standard Isd 39 under different stress conditions

Environments	BSRIK 45	Isd 39	Yield increase (%)
Drought (Rainfed)	79.65	73.75	8.0
Salinity (15 ds/m)	95.80	93.50	2.5
Flood (120 cm flowing water for 30 days)	95.60	88.20	8.3
Waterlog (40 cm stagnant water for 4 months)	88.80	75.30	17.9

Table 4 explains that in drought, salinity, flood and waterlogged stress conditions BSRIK 45 yielded 8%, 2.5%, 8.3% and 17.9% more than the standard variety Isd 39.

Table 5. Ratoon cane yield (tha^{-1}) of BSRIK 45 against the standard Isd 39 in Zonal Yield Trial (Average of two years)

Variety/Clone	Locations		Mean
	Ishurdi	Rajshahi	
BSRIK 45	83.38	75.23	79.30
Isd 39	80.13	66.92	73.52

In respect of ratoon cane, it was observed from the Table 5 that BSRIK 45 was a good ratooner also and was found to produce higher cane yield than the standard variety Isd 39.

From the results it was evident that the newly released sugarcane variety BSRIK 45 was overall superior than the standard variety and the other clones. The variety was also tolerant to various stress environments. So, the farmers of mill and non-mill zones as well as sugar industries will get benefit through cultivating this new variety especially in stress prone areas of Bangladesh.

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