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Variations in fruit and seed traits in jamun (*Syzygium cuminii* Skeels)

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Abstract

Jamun fruits collected from different locations showed wided variations in fruit and seed characters. Among 49 genotypes, SC1, SC27, SC33 and SC40 had lesser seed weight ranging from 0.3 to 0.8 g, therefore these genotypes can be considered as seedless types. Also, these genotypes had least seed content *viz.*, 9.1 % (SC1), 10.3 % (SC27), 6.5 % (SC33) and 5.6 % (SC40). Nevertheless, these genotypes have two types of fruit in which the bigger fruits have thin seed and others have no seed. In seedless fruits, the aborted ovule was recorded. In addition, the seedless genotypes were found to have higher total soluble solids and sugars. Therefore, these genotypes can be used in the food industry particularly for the preparation of value added products and also as table fruit variety.

Key words: Jamun, genotypes, fruit traits, seed traits, seedless fruits.

Introduction

Jamun (*Syzygium cuminii* Skeels) is an evergreen tropical tree grown in India, Bangladesh, Burma, Nepal, Pakistan, Sri Lanka and Indonesia. The fruits are violet or white in colour and rich in minerals and vitamins particularly with high source of iron, vitamin A and C (Singh and Srivastava, 2000). Jamun has been viewed as an antidiabetic plant and is an integral part in the various alternative systems of medicine. Various extracts of jamun possess a range of pharmacological properties such as anti-bacterial, anti-fungal, anti-viral, anti-inflammatory, anti-ulcerogenic, cardioprotective, anti-allergic, anti-cancer, radioprotective, antioxidant, hepatoprotective, anti-diarrheal, hypoglycemic and anti-diabetic effects (Stephen, 2012). The plant is rich in compounds containing anthocyanins, glucoside, ellagic acid, isoquercetin, kaemferol and myrecetin (Ayyanar and Subash-Babu, 2012.). The seeds are claimed to contain an alkaloid 'jambosine' and glycoside 'jambolin' or 'antimellin' which halts conversion of starch into sugar in the body system (Morton, 1987).

The most common and simplest method of raising the jamun tree is from seed. However, large scale variations with respect to fruit morphology, fruit quality, maturity and productivity have been reported owing to its cross pollination nature and seed propagation. However, seedless types were also been reported from the natural population. In this regard, seedlessness can contribute in increasing the quality of the fruits. Shakya *et al.* (2010) found the variation from seed propagation with the J-22 selection being the most dissimilar from other accessions in that it is unique in being seedless. Shahnawaz and Sheikh (2011) studied the variations in fruit and seed and found that improved cultivar was superior in all parameters analyzed whereas indigenous cultivar was found substandard except seed portion which was more in it. The genotypes possessing thin seed with negligible seed weight (0.12 - 0.31g) might be used as seedless jamun (Patel *et al.*, 2005).

Generally, jamun produce fruits in one season and they are highly perishable. Also, it cannot be preserved as such due to the presence of the seed. Therefore, the development of seedless cultivar is important particularly for the preparation of value added items in the food industry. It is also helpful for the growers to get more remuneration in the market. Whether, is it possible to develop a seedless genotype? Certainly, it is possible by selection process or artificial means. Therefore, the present study was formulated to find out the variations in fruit and seed traits of diverse jamun genotypes, identification of the seedless genotypes and assembling in one place for further development.

Materials and methods

The study was conducted at Vegetable Research Station, Tamil Nadu Agricultural University, Palur, Cuddalore District (India) (11^0 45' N latitude and 75^0 40' E longitude) during 2013 to 2017. The jamun fruits of 49 genotypes (SC1 to SC49) available in the natural population were collected from different parts of Tamil Nadu *viz.*, Coimbatore, Cuddalore, Erode, Madurai, Namakkal, Thanjavur, Theni and Villupuram Districts. Besides, the fruits were collected in Pondicherry areas. Then, the physical traits of the fruits and seeds were recorded in all the collected genotypes. Also, the pulp : seed proportion and seed content for all the genotypes were calculated. In addition, the fruits of all the genotypes were evaluated for the total soluble solids (TSS) using Digital Bench Refractometer as per the method described by Mazumdar and Majumder (2003).

Also, the fruit samples of the seedless genotypes SC1 and SC27 were collected along with the seeded genotype SC2 and analyzed for its different biochemical constituent's. In which, the moisture content of the fruits was observed by hot air oven method. The pH of the fruit was measured in pH meter and expressed in number. Fruit titrable acidity and vitamin C content were analyzed by the method described by AOAC (2000) and Rahman Khan *et* *al.* (2006), respectively. The method described by Prosky *et al.* (1985) was used to determine the fibre content in the fruit. Sugars (total sugar and reducing sugar) were analyzed through Lane and Eynon method as described by James (1995). Data were analyzed using ANOVA (Panse and Sukhatme, 1967) at 5 % probability level.

Results and discussion

The results showed that the various genotypes collected from different locations recorded variations in fruit and seed traits (Table 1 and 2). The length of the fruit was witnessed from 2.1 to 4.8 cm while, the girth was 3.5 to 8.0 cm in different genotypes. Nevertheless, wider variations were observed in fruit weight in

Table 1. Fruit and seed traits of the different genotypes of jamun

Genotypes	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	Pulp weight (g)	Pulp content (%)	Seed length (cm)	Seed girth (cm)	Seed weight (g)	Seed content (%)	Pulp : seed ratio	TSS (^{0}B)
SC1	2.9	5.3	4.4	4.0	90.9	1.1	1.9	0.4	9.1	1:0.09	17.6
SC2	3.5	6.1	4.8	4.1	85.4	2.0	3.2	0.7	14.6	1:0.14	16.0
SC3	3.3	6.8	5.2	4.2	80.7	1.9	3.7	0.9	17.3	1:0.17	19.2
SC4	3.4	7.0	5.8	4.8	82.7	1.9	3.6	0.9	15.5	1:0.16	15.0
SC5	3.0	6.3	4.5	3.3	73.3	2.1	3.8	1.2	26.7	1:0.27	10.8
SC6	3.3	6.9	5.7	4.9	85.9	1.7	3.1	0.7	12.3	1:0.12	15.0
SC7	2.5	4.8	2.3	1.8	78.2	1.6	2.8	0.5	21.7	1:0.21	14.8
SC8	2.8	4.9	2.1	1.4	66.7	2.1	3.2	0.8	38.1	1:0.38	8.8
SC9	3.0	5.7	3.6	2.3	63.9	2.2	4.0	1.3	36.1	1:0.36	15.3
SC10	2.2	4.1	1.5	0.8	53.3	1.5	3.0	0.7	46.6	1:0.47	20.4
SC11	2.8	4.6	1.7	0.9	52.9	2.2	3.4	0.7	41.1	1:0.41	9.4
SC12	2.1	3.5	1.3	0.7	53.8	1.7	3.0	0.5	38.5	1:0.38	6.9
SC13	2.6	4.4	1.5	0.8	53.3	2.0	3.3	0.8	55.3	1:0.53	13.8
SC14	3.9	7.5	7.2	5.7	79.2	1.5	2.4	1.5	20.8	1:0.20	14.6
SC15	3.7	7.3	6.6	5.3	80.3	2.4	3.9	1.3	19.6	1:0.20	13.0
SC16	4.1	7.6	7.6	5.6	73.6	2.7	4.7	4.7	61.8	1:0.62	11.2
SC17	3.7	7.2	5.7	4.3	75.4	2.2	4.0	1.4	24.6	1:0.25	16.8
SC18	3.7	7.4	6.3	4.7	74.6	2.4	4.4	1.6	25.4	1:0.25	16.4
SC19	3.6	7.1	5.5	4.0	72.7	2.3	4.1	1.5	27.3	1:0.27	15.1
SC20	3.8	7.6	6.6	4.8	72.7	2.5	4.5	1.8	27.3	1:0.27	15.0
SC21	4.6	8.0	8.4	6.6	78.5	1.8	2.8	1.8	21.4	1:0.21	15.5
SC22	3.8	7.2	5.3	4.0	75.4	2.3	3.8	1.2	22.6	1:0.23	17.9
SC23	3.7	7.8	7.7	6.2	80.5	2.6	4.2	1.5	19.5	1:0.19	13.6
SC24	4.5	7.5	7.8	6.2	79.4	2.7	4.1	1.5	19.2	1:0.19	14.0
SC25	4.5	7.7	8.5	7.1	83.5	2.5	4.2	1.4	16.5	1:0.16	15.2
SC26	4.8	7.6	8.6	7.6	88.3	2.9	3.4	1.1	12.8	1:0.12	10.0
SC27	4.1	6.9	7.8	7.2	92.3	1.6	2.6	0.8	10.3	1:0.10	10.9
SC28	3.1	5.7	3.9	2.6	66.6	2.0	3.5	1.3	33.3	1:0.33	10.2
SC29	3.6	7.1	5.7	4.5	78.9	2.2	3.7	1.2	21.1	1:0.21	18.2
SC30	4.7	7.6	9.4	8.2	87.2	2.3	3.5	1.1	11.7	1:0.11	12.1
SC31	3.4	5.9	3.9	2.9	74.3	2.1	3.3	0.9	23.0	1:0.23	17.0
SC32	3.2	5.8	3.9	3.0	76.9	1.9	3.0	0.9	23.0	1:0.23	12.8
SC33	3.7	6.6	6.2	5.8	93.5	0.9	1.4	0.4	6.5	1:0.06	14.1
SC34	2.2	4.8	1.8	1.2	66.6	1.7	3.2	0.6	46.2	1:0.33	15.6
SC35	2.4	4.7	2.2	1.5	68.1	2.1	3.4	0.6	27.3	1:0.27	17.3
SC36	3.0	5.4	3.7	2.6	70.2	4.6	3.4	1.1	29.7	1:0.29	16.0
SC37	3.7	6.5	5.4	4.1	75.9	2.2	4.1	1.4	25.9	1:0.26	13.1
SC38	3.4	6.4	5.1	3.8	74.5	2.4	4.1	1.3	25.5	1:0.25	12.9
SC39	4.1	6.7	6.7	5.7	85.0	2.0	3.3	1.0	14.9	1:0.15	13.6
SC40	3.6	6.1	5.4	5.1	94.4	0.7	1.3	0.3	5.6	1:0.06	14.6
SC41	2.9	5.9	4.3	3.7	86.0	1.8	2.5	0.6	14.0	1:0.14	13.1
SC42	3.2	5.8	4.5	3.8	82.6	1.9	3.3	0.7	15.6	1:0.16	15.4
SC43	3.2	6.6	5.0	4.3	86.0	2.0	3.2	0.7	14.0	1:0.14	17.6
SC44	3.2	5.9	4.9	4.2	85.7	2.0	3.3	0.7	14.3	1:0.14	9.2
SC45	3.4	6.2	6.0	5.2	86.6	2.1	3.4	0.8	13.3	1:0.13	14.8
SC46	2.3	3.9	4.0	3.5	87.5	1.7	2.5	0.5	12.5	1:0.13	10.8
SC47	3.3	6.3	5.7	5.0	87.7	2.1	3.6	0.8	14.0	1:0.14	15.8
SC48	2.8	4.8	3.8	3.2	84.2	2.0	3.1	0.6	15.8	1:0.16	10.6
SC49	3.0	5.2	4.7	4.0	85.1	2.1	3.2	0.6	12.8	1:0.13	17.0
SEd	0.03	0.04	1.2	0.04	1.3	0.03	0.03	0.04	0.06	-	0.09
CD(P=0.05)	0.06	0.07	2.4	0.08	2.5	0.06	0.06	0.08	0.12	-	0.18

Table 2. Variation in fruit and seed traits of the different genotypes of jamun

Parameters	Mean	Minimum	Maximum	Range	Standard Deviation	CV
Fruit length (cm)	3.37	2.10	4.80	2.70	0.66	19.57
Fruit girth (cm)	6.22	3.50	8.00	4.50	1.16	18.63
Fruit weight (g)	5.11	1.30	9.40	8.10	2.04	39.94
Pulp weight (g)	4.11	0.70	8.20	7.50	1.85	44.96
Pulp content (%)	77.77	52.90	94.40	41.50	10.41	13.38
Seed length (cm)	2.07	0.70	4.60	3.90	0.56	27.27
Seed girth (cm)	3.36	1.30	4.70	3.40	0.71	21.15
Seed weight (g)	1.05	0.30	4.70	4.40	0.66	62.94
Seed content (%)	22.90	5.60	61.80	56.20	12.23	53.42
Pulp : seed ratio	0.22	0.06	0.62	0.56	0.12	52.38

which genotype SC12 had lowest weight (1.3 g) and SC30 had highest (9.4 g). The genotype SC12 had lesser pulp weight (0.7 g). Similarly, the genotype SC30 recorded highest pulp weight (8.2 g). In addition, the pulp content ranged from 52.9 to 94.4 per cent in which SC40 has recorded the highest. However, the seed traits like seed length (0.7 to 4.6 cm) and girth (1.3 to 4.7 cm) differed among the genotypes in which genotype SC40 had least values (0.7 and 1.3 cm). In addition, this genotype had lowest seed weight (0.3 g) followed by SC1 and SC33 (0.4 g) and SC27 (0.8 g). Also, these genotypes recorded the lesser seed content *viz.*, 5.6 (SC40), 6.5 (SC33), 9.1 (SC1) and 10.3 per cent (SC27). Also, the pulp content was high in these genotypes *viz.*, 90.9 (SC1), 92.3 (SC27), 93.5 (SC33) and 94.4 per cent (SC40). Similarly, the pulp : seed ratio was meager {1:0.06 (SC33 & SC40), 1:0.09 (SC1) and 1:0.10 (SC27)} in these genotypes (Table 1).

Total soluble solids varied highly with the genotypes and some seeded genotypes like SC3 (19.2 ^{o}B) and SC10 (20.4 ^{o}B) recorded the highest contents. However, the seedless genotypes SC1 (17.6 ^{o}B), SC27 (14.1 ^{o}B) and SC40 (14.6 ^{o}B) showed the remarkable levels. Therefore, it indicates that the genotypes SC1, SC27, SC33 and SC40 have seedless fruits and among the four genotypes SC40 showed the least seed content. The genotypes having thin seed with negligible seed weight (<0.3 g) might be used as seedless jamun (Patel *et al.*, 2005). Shahnawaz and Sheikh (2011) found that the physical properties of jamun fruit varied among the cultivars and the weight of fruit determines its acceptance to consumers and thereby the market price.

The role of phytohormones is of fundamental importance in fruit set and regulation (Pandolfini, 2009). In which, several studies addressed in fruit set regulation at the transcriptomic level demonstrating that many phytohormones concur to regulate this process in a complex way (Vriezen, 2008). Ozga and Reinecke (1999) opined that the auxins and gibberellins are the important phytohormones that play a prominent role in coordinating fruit growth and seed development. Of which, gibberellic acid (GA) is commonly used for seedless fruit production. The difference in the synthesis of GA or external application may lead to the formation of seedless fruits.

While grouping the fruits of these seedless genotypes into different grades *viz.*, bigger (>5 g), medium (2-5 g) and smaller (<2 g), the bigger and medium size fruits were found in all the genotypes. The smaller fruits were noticed only in the genotype SC1. Also, the bigger fruits in all the four genotypes have the seed weight of 0.5 g to 0.8 g. Similarly, the medium size fruits in the genotypes SC1 and SC27 had seed weight of 0.6 and 0.2 g, respectively. However, the medium size fruits in the genotypes SC33 and SC40 have no seeds. Likewise, the seeds were absent in the smaller fruits of the genotype SC1 (Table 3). Similar results of seed with negligible seed weight have been described as seedless jamun (Patel *et al.*, 2005; Singh *et al.*, 2007; Ghojage *et al.*, 2011).

The biochemical constituents of the seedless and seeded fruits showed that the significant differences were observed in all the parameters except the fibre content (Table 4). Among the genotypes, SC2 recorded the highest acidity (1.28 %) and SC1 had lowest pH (3.8) when compared with other genotypes. This acidic nature may be responsible for astringency in taste (Noomrio and Dahot, 1996; Shahnawaz and Sheikh, 2011).) and lower pH of sample is favorable for higher shelf life (Hasnain and Ali, 1990). However, vitamin C content was more (52.4 mg 100 g^{-1}) in the seeded genotype (SC2) when compared with seedless genotypes. Nevertheless, the genotypes *viz.*, SC27 (11.5 %) and SC1 (4.7 %) were recorded with the highest total sugar and reducing sugar,

Table 3. Fruit and seed traits of the different seedless genotypes of jamun

Fruit size	Fruit weight (g)				Seed weight (g)				Seed content (%)			
	SC1	SC27	SC33	SC40	SC1	SC27	SC33	SC40	SC1	SC27	SC33	SC40
Bigger fruits (>5 g)	7.8	11.6	9.1	7.6	0.8	0.6	0.7	0.5	10.2	5.2	7.7	6.6
Medium fruits (2-5 g)	4.4	4.1	3.3	3.3	0.6	0.2	0	0	13.6	4.9	0	0
Smaller fruits (<2 g)	1.2	0	0	0	0	0	0	0	0	0	0	0
	Genotype	Size			Genotype	Size			Genotype	Size		
SEd	0.02	0.02			0.02	0.02			0.8	0.7		
CD (*P*=0.05)	0.04	0.04			0.04	0.03			1.6	1.4		

Table 4. Biochemical analysis of seeded and seedless jamun fruits

Genotypes	Moisture (%)	Acidity (%)	pH	Vitamin C (mg/100g)	Fibre (g)	Total sugar (%)	Reducing sugar (%)
SC2 (seeded)	86.8	1.28	4.1	52.4	0.22	8.9	3.8
SC1 (seedless)	87.9	1.15	3.8	38.8	0.22	10.5	4.7
SC27 (seedless)	85.2	0.96	4.4	22.0	0.22	11.5	2.0
SEd	0.03	0.004	0.04	0.03	0.005	0.04	0.04
CD (*P*=0.05)	0.06	0.008	0.08	0.06	NS	0.08	0.08

respectively (Table 4). Similar variability in fruit traits of different jamun accessions were studied by many scientists (Singh and Singh, 2005; Ghojage *et al.*, 2011; Singh *et al.*, 2015; Vijay *et al.*, 2017; Plathia *et al.*, 2018). Therefore, it is evidenced that the seedless genotypes also possess higher nutritive values like the seeded fruit types and can be promoted for the preparation of value added products. Based on the quality traits, these seedless genotypes were grafted and planted at Vegetable Research Station, Palur for further development into a better cultivar.

It is concluded that the wider variations was recorded in fruit and seed traits of different jamun genotypes in which the genotypes *viz.*, SC1, SC27, SC33 and SC40 had lesser seed weight as that of the earlier findings (Patel *et al.*, 2005) and can be considered as seedless fruits. Therefore, these genotypes are planted in the germplasm area and are under evaluation for the release into a new variety.

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