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# Genetic diversity in jamun under semi-arid ecosystem of western India

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**Abstract**

An investigation was undertaken to evaluate the performance of 14 genotypes of jamun at Experimental Farm of Central Horticultural Experiment Station (ICAR-CIAH), Vejalpur, Panchmahals (Godhra), Gujarat under rainfed hot semi-arid ecosystem of western India during the years 2015 and 2016. These genotypes were studied to determine the variability with regards to vegetative growth, flowering and fruit quality attributes under hot semi-arid conditions. The results of study showed considerable variation with respect to vegetative, floral, yield and physico-chemical characters of fruit. The vegetative growth in terms of annual extension growth varied between 34.15 to 58.00 cm being the lowest in CHESJ-28 and the highest in CHESJ-32. The period of panicle emergence and flowering was recorded in February in almost all the genotypes. Panicle length ranged from 10.00 to 14.50 cm. The peak period of fruit set was noticed in the month of March, whereas fruit ripening started from 4th week of May and continued up to 4th week of June in different genotypes. Considerable variation in different flower organs was also observed amongst the genotypes. Flower length, breadth, calyx length, breadth ranged between 09.20-13.28 mm, 09.11-10.29 mm, 7.50-9.00 mm and 4.21-5.18 mm respectively. The maximum fruit yield (30.28 kg/ plant), fruit weight (18.00 g), pulp content (84.44%), TSS (17.42°Brix), total sugar (10.60%) was recorded in CHESJ-30. Based on the various desired traits, the genotypes, CHESJ-30 was found to be promising.

**Key words**: Diversity, flower length, fruit yield, ovary, panicle length, ripening time

## Introduction

The jamun, botanically known as *Syzygium cuminii* Skeels, is an economically multipurpose tree of the family Myrtaceae which is one of the important rainfed semi-arid fruit crops, rich in nutrients, hardy in nature, having good processing quality with wider adaptability to varied edapho-climatic conditions. Gradually, it is attaining its position among the important fruits of India. The tree is medium size, evergreen with semi-spreading growth habit. It produces purple delicious fruits with prominent seeds.

Jamun is a heterozygous, cross-pollinated fruit crop and as such existing seedling population exhibit a wide range of diversity, which aids in the selection of the superior desirable genotypes. Elite genotypes were collected from diversity rich areas based on the horticultural traits and evaluated under field condition to identify elite genotypes having earliness, short stature, precocious bearer, high yielder, high pulp content and suitable for commercial cultivation in closer spacing. Such variations were observed in terms of flowering, fruiting, yield and fruit quality attributes in jamun, chironji, mahua, tamarind, bael, custard apple, khirni and phalsa in different agro-climatic conditions (Patel *et al.*, 2005; Singh *et al., 2006;* Singh and Singh, 2005; Singh *et al., 2008;* Singh *et al.*, 2014; Yadav *et al.*, 2017; Malik *et al.*, 2012; Malik *et al.*, 2013 and Singh *et al.*, 2019c). The fruit is good source of iron, sugars, minerals, protein, carbohydrate *etc.* Fully ripe fruits are eaten fresh and can be processed into beverages like jelly, jam, squash, wine, vinegar and pickles. Fruits are used as an effective medicine against diabetes, heart and liver trouble (Singh *et al.*, 2019 a,b). The seed powder has also reputation of being useful in the treatment of diabetes. The plant can tolerate drought conditions, if occurs for some time as well as heavy rainfall conditions. Present investigation was carried out to find out variability in plant growth, flowering, fruiting and fruit quality attributes of different genotypes of jamun, so that the suitable genotype could be identified for commercial exploitation.

## Materials and Methods

The location of the experiment is 113 m above MSL on latitude 22°41' 38" N and longitude 73° 33' 22" E and is characterized by hot semi-arid climate. The annual rainfall is mainly confined to three months (July-September) and actual mean precipitation is about 750 mm with number of rainy days average to about 32. The mean summer temperature is 32.9°C while the mean winter temperature is 21.3°C indicating that the area falls under hyperthermic soil regime. The mean annual maximum and minimum temperatures vary from 42-44°C (May) and 6-9°C (January), respectively. The experimental soil type was characterized with available N (151.25 kg/ha), P (8.22 kg/ha) and K (143.50 kg/ha) and organic carbon (0.33%), while EC and pH, bulk density and

hydraulic conductivity of soil were 0.14 $dSm^{-1}$, 8.25, 1.42g/cc and 0.29 cm/hr, respectively. The soil depth of experimental field ranged from 0.65 to 1.0 m derived from mixed alluvial basalt, quartzite, granite and layers of limestone which falls under semi-arid hot climate.

A total of 14 genotypes, established through *in-situ* softwood grafting, was laid out in randomized block design with 3 replications. Observations on plant growth, flowering, fruiting and fruit quality attributes were observed during two consecutive years 2015 and 2016, and mean data were subjected to statistical analysis. Twenty shoots spread over four directions on each tree were tagged and detail observations on floral traits were recorded. Forty fruits were randomly selected from all the directions of the plant for fruit quality attributes. Total soluble solids, acidity, vitamin C and sugars were analyzed by the methods as outlined by A.O.A.C. (1980). The mean data were statistically analyzed as per method demonstrated by Gomez and Gomez (1984).

**Results and Discussion**

The data on vegetative growth of different genotypes depicted in Table 1 showed significant differences in respect of their vegetative characters. The vegetative growth in terms of annual extension growth varied between 34.15 to 58.00 cm being the lowest in CHESJ-28 and the highest in CHESJ-32. Among the genotypes, growth habit was observed as spreading, upright and semi- spreading. The difference in vegetative growth of different genotypes may be due to their inherent characters under varied agro-climatic conditions. Similar results with respect to vegetative characters have been reported by Singh *et al.* (2006) in chironji, Singh *et al.* (2016b) in khirni and Singh *et al.* (2014) in bael under hot semi-arid conditions of western India.

In general, peak period of panicle emergence was

Table 1. Plant growth, flowering and fruiting pattern of jamun genotypes (Mean data 2015 and 2016)

| Genotype | Annual extension growth (cm) | Growth habit | Peak period of panicle emergence | Peak period of flowering | Peak period of fruit set | Panicle length (cm) | Ripening time |
|---|---|---|---|---|---|---|---|
| CHESJ -27 | 43.70 | Spreading | 2nd week Feb | 4th week Feb | 1st week March | 10.45 | 3rd week June |
| CHESJ -28 | 34.15 | Spreading | 3rd week Feb | 4th week Feb | 2nd week March | 14.50 | 4th week May |
| CHESJ -29 | 45.10 | Semi - spreading | 2nd week Feb | 4th week Feb. | 2nd week March | 12.17 | 4th week May |
| CHESJ -30 | 46.21 | Semi - spreading | 2nd week Feb | 4th week Feb. | 2nd week March | 11.32 | 4th week June |
| CHESJ -31 | 54.50 | Upright | 3rd week Feb | 1st week March | 3rd week March | 10.00 | 4th week May |
| CHESJ -32 | 58.00 | Semi - spreading | 2nd week Feb | 4th week Feb | 2nd week March | 12.50 | 4th week May |
| CHESJ -33 | 55.89 | Semi - spreading | 3rd week Feb | 1st Week March | 3rd week March | 14.00 | 3rd week June |
| CHESJ -34 | 42.12 | Semi - spreading | 2nd week Feb | 4th week Feb | 1st week March | 13.12 | 4th week June |
| CHESJ -35 | 56.40 | Upright | 2nd week Feb | 4th week Feb | 2nd week March | 11.20 | 4th week June |
| CHESJ -36 | 53.10 | Spreading | 1st week Feb | 4th week Feb | 1st week March | 12.25 | 3rd week June |
| CHESJ -37 | 52.10 | Semi - spread ing | 3rd week Feb | 1st week March | 3rd week March | 10.24 | 3rd week June |
| CHESJ -38 | 43.80 | Upright | 2nd week Feb | 4th week Feb | 2nd week March | 12.50 | 4th week May |
| CHESJ -39 | 46.10 | Upright | 2nd week Feb | 4th week Feb | 1st week March | 14.00 | 4th week June |
| CHESJ -40 | 47.20 | Sp reading | 2nd week Feb | 4th week Feb | 3rd week March | 11.13 | 4th week May |
| CD (5%) | 1.23 | ------ | ---- | ------ | ---- | ----- | ---- |

observed in the month of February in all the genotypes and these genotypes exhibited considerable variations. Panicle initiation starts from 1st week of February and continued up to 3rd week of February. The peak period of flowering was recorded in February and March in all genotypes. Flowering was noted in 4th week of February in CHESJ-27, CHES-28, CHES-29, CHESJ-30, CHESJ-32, CHESJ-34, CHESJ-35, CHESJ-36, CHESJ-39 and CHESJ-40. It was recorded in1st week of March in CHESJ-31, CHESJ-33 and CHESJ-37 (Table 1). Flower bud differentiation is influenced by the prevailing agro-climatic conditions of the area. More or less similar findings have been reported by earlier workers in different fruit crops *viz.*, jamun (Patel *et al.*, 2005, Singh *et al.*, 2007), tamarind (Singh *et al.*, 2008), bael (Singh *et al.*, 2014), khirni (Singh *et al.*, 2016b), mahua (Singh and Singh, 2005) under different climatic conditions.

The length of panicle directly associated with the number of flowers and fruit setting. Table 1 clearly indicates the significant variation in the length of panicle which varied from 10.00 to 14.50 cm among different genotypes of jamun. The maximum length was observed in CHESJ-28 (14.50 cm) followed by CHESJ-39 (14.00 cm) and CHESJ-33 (14.00 cm), while it was recorded minimum in CHESJ-31 (10.00 cm). Variation in the length of panicle may be due to genetic makeup and their adaptability to varied climatic conditions. These findings are in accordance with results as reported by Singh *et al.* (2008) in tamarind. Wide variability in respect to flowering was recorded in jamun and chironji under different

Table 2. Floral traits in different jamun genotypes (Mean data 2015 and 2016)

| Genotypes | Flower length (mm) | Flower breadth (mm) | Length of calyx tube (mm) | Breadth of calyx tube (mm) | Petal length (mm) | Petal breadth (mm) | Stamen length (mm) | Ovary length (mm) | Ovary breadth (mm) | Style length (mm) |
|---|---|---|---|---|---|---|---|---|---|---|
| CHESJ-27 | 12.10 | 10.12 | 8.22 | 4.22 | 4.21 | 3.02 | 5.20 | 3.10 | 2.15 | 8.20 |
| CHESJ-28 | 12.32 | 10.20 | 8.93 | 4. 53 | 4.23 | 3.20 | 6.55 | 3.22 | 2.10 | 7.57 |
| CHESJ-29 | 11.20 | 9.20 | 7.93 | 4.52 | 4.22 | 3.50 | 6.02 | 3.10 | 2.50 | 7.23 |
| CHESJ-30 | 12.30 | 9.52 | 7.50 | 4.15 | 4.10 | 4.00 | 8.93 | 3.50 | 2.75 | 8.28 |
| CHESJ-31 | 10.20 | 9.80 | 7.82 | 4.22 | 4.22 | 3.50 | 9.00 | 3.50 | 2.54 | 8.91 |
| CHESJ-32 | 11.22 | 10.21 | 8.23 | 4.60 | 4.56 | 3.2 1 | 8.23 | 3.63 | 2.55 | 8.62 |
| CHESJ-33 | 10.30 | 10.00 | 8.42 | 4.52 | 4.53 | 3.53 | 7.50 | 3.05 | 2.52 | 8.20 |
| CHESJ-34 | 9.20 | 9.11 | 8.90 | 5.00 | 5.30 | 3.60 | 7.00 | 3.11 | 2.50 | 7.55 |
| CHESJ-35 | 13.23 | 9.34 | 9.10 | 5.18 | 5.20 | 3.52 | 8.53 | 3.50 | 2.72 | 7.63 |
| CHESJ-36 | 13.10 | 9.80 | 8.52 | 4.52 | 5.13 | 3.63 | 8.23 | 3.00 | 2.52 | 7.53 |
| CHESJ-37 | 13.28 | 10.33 | 9.00 | 5.12 | 5.19 | 3.50 | 8.58 | 3.50 | 2.70 | 7.63 |
| CHESJ-38 | 12.10 | 10.13 | 8.20 | 4.21 | 4.00 | 3.11 | 5.20 | 3.10 | 2.00 | 8.20 |
| CHESJ-39 | 12.33 | 10.29 | 8.90 | 4.58 | 4.23 | 3.22 | 6.55 | 3.20 | 2.12 | 7.50 |
| CHESJ-40 | 11.23 | 9.23 | 7.93 | 4.53 | 4.20 | 3.50 | 6.00 | 3.07 | 2.53 | 7.20 |
| CD (5%) | 0.10 | 0.08 | 0.06 | 0.05 | 0.07 | NS | 0.05 | NS | NS | 0.03 |

Table 3. Fruit quality attributes of jamun genotypes (Mean data 2015 and 2016)

| Genotype | Fruit yield/ Plant (kg) | Fruit weight (g) | Fruit length (cm) | Fruit breadth (cm) | Pulp weight (g) | Pulp percent | TSS (%) | Acidity (%) | Total sugar (%) | Reducing sugar (%) | Vitamin C (mg/100g) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CHESJ27 | 20.32 | 16.72 | 3.00 | 2.13 | 13.00 | 77.75 | 14.10 | 0.35 | 9.80 | 3.99 | 42.56 |
| CHESJ28 | 23.50 | 17.00 | 3.10 | 2.20 | 14.10 | 82.94 | 16.68 | 0.39 | 9.00 | 3.85 | 43.43 |
| CHESJ29 | 28.65 | 16.20 | 2.80 | 2.20 | 13.30 | 82.09 | 13.29 | 0.38 | 9.00 | 3.84 | 42.13 |
| CHESJ30 | 30.28 | 18.00 | 3.20 | 2.40 | 15.20 | 84.44 | 17.42 | 0.37 | 10.60 | 5.95 | 45.07 |
| CHESJ31 | 27.20 | 15.00 | 2.50 | 2.12 | 12.34 | 82.26 | 14.57 | 0.40 | 8.90 | 3.59 | 43.00 |
| CHESJ32 | 28.42 | 13.00 | 2.50 | 2.06 | 10.16 | 78.15 | 13.19 | 0.42 | 8.80 | 3.66 | 42.00 |
| CHESJ33 | 21.95 | 13.90 | 2.19 | 2.10 | 10.70 | 76.97 | 15.00 | 0.42 | 8.85 | 3.70 | 40.11 |
| CHESJ34 | 23.65 | 17.77 | 3.09 | 2.13 | 14.48 | 81.48 | 15.50 | 0.40 | 10.0 | 3.80 | 42.60 |
| CHESJ35 | 20.43 | 15.24 | 2.93 | 2.02 | 12.20 | 80.05 | 14.10 | 0.42 | 9.70 | 3.90 | 42.12 |
| CHESJ36 | 23.28 | 17.40 | 2.70 | 2.03 | 13.20 | 75.86 | 13.00 | 0.38 | 8.76 | 3.54 | 41.05 |
| CHESJ37 | 25.70 | 09.14 | 1.98 | 2.01 | 07.28 | 79.64 | 13.14 | 0.35 | 9.44 | 3.95 | 40.45 |
| CHESJ38 | 19.50 | 17.00 | 2.70 | 2.10 | 13.35 | 78.52 | 14.58 | 0.39 | 9.60 | 4.53 | 39.00 |
| CHESJ39 | 18.00 | 16.00 | 2.66 | 2.09 | 13.20 | 82.50 | 14.00 | 0.45 | 9.80 | 3.90 | 40.00 |
| CHESJ40 | 18.51 | 14.00 | 2.60 | 2.00 | 11.60 | 82.85 | 13.10 | 0.43 | 8.93 | 3.74 | 38.67 |
| CD (5%) | 1.12 | 1.14 | 0.31 | 0.08 | 1.10 | 2.00 | 0.21 | 0.01 | 0.40 | 0.32 | 1.11 |

climatic conditions (Singh and Singh, 2012; Singh *et al.*, 2006; Singh *et al.*, 2010).

Peak period of fruit setting took place from 1st week of March and lasted up to 3rd week of March. However, it may differ in different agro-climatic condition. Variability in fruit set was also recorded in jamun genotypes (Singh *et al.*, 2019 a,b). Fruits ripened in 4th week of May in CHESJ-28, CHESJ-29, CHESJ-30, CHESJ-31, CHESJ-32, CHESJ-34, CHESJ-35, CHESJ-38, CHESJ-39 and CHESJ-40. CHESJ-37, CHESJ-33 and CHESJ-36 ripened in 3rd week of June, while rest of the genotypes ripened in 4th week of June (Table 1). Such variations in fruit ripening have been reported in different fruit crops like chironji (Singh *et al.*, 2016a), bael (Singh *et al.*, 2014) and phalsa (Singh *et al.*, 2019c).

In all the genotypes, significant variation was observed for flower size, calyx tube size, petal size, stamen and style length (Table 2). The minimum flower length and breadth was observed in CHESJ-34 and the maximum length and breadth of the flower was recorded in CHESJ-37. Calyx tube length ranged between 7.50-9.10 mm being the highest in CHESJ-35 and the lowest in CHESJ-30. Breadth of calyx ranged between 4.15-5.18 being highest in CHESJ-35. The maximum petal length was recorded CHESJ-34 and it was minimum in CHESJ-38. Wide variation in stamen length was observed which ranged between 5.20-9.00 mm whereas style length ranged between 7.20-8.91 mm. However differences for ovary size and petal breadth could not reach the level of significance among the genotypes. Such variations in floral organs of fruit crops have been reported by Singh *et al.* (2014) in bael under different agro-climatic conditions.

Variability recorded in yield and fruit weight is presented in Table 3. Results of study revealed significant differences in yield and fruit weight among the genotypes. Yield per plant was recorded the highest in CHESJ-30 (30.28 kg) followed by CHESJ-29 (28.65 kg), CHESJ-32 (28.42 kg) and CHESJ-31 (27.20 kg), and it was recorded the lowest in CHESJ-39 (18.00 kg). The maximum fruit weight was recorded in CHESJ-30 (18.00 g) followed by CHESJ-34 (17.77 g) and CHESJ-36 (17.40 g), while it was recorded the lowest in CHESJ-37 (9.14g). Variation in fruit yield and weight in various fruit crops have been reported by Singh *et al.* (2014) in bael, under rainfed semi-arid conditions of western India.

Pulp content was recorded the maximum in CHESJ-30 (84.44%), closely followed by CHESJ-28 (82.94%), CHESJ-40 (82.85%) and CHESJ-39 (82.50%), it was found to be the minimum in CHESJ-36 (75.86%). Jamun fruits are also rich source of total soluble solids, sugars and vitamin C, and these values varied significantly in different genotypes (Table 3). Total soluble solids and total sugar content of fruits ranged from 13.00 to 17.42 °Brix and 8.76 to 10.60%, respectively in different genotypes. The highest TSS and total sugar was recorded in CHESJ-30, followed by CHESJ-28 and CHESJ-34. Vitamin C content was found to be highest in CHESJ-30 (45.07 mg/100g) closely followed by CHESJ-28 (43.43 mg/100g) and CHESJ-31 (43.00 mg/100g) and the lowest in CHESJ-40 (38.67 mg/100g). Malik *et al.* (2012) and Singh *et al.* (2016b) have also recorded the remarkable variability in relation to fruit quality attributes of khirni. Based on the horticultural traits studied, the genotype, CHESJ-30 was found to be promising under rainfed hot semi-arid conditions of western India.

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