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Genetic divergence in jamun under semi-arid ecosystem of western India

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ABSTRACT

An investigation was undertaken to evaluate the performance **of 26 genotypes of jamun under rainfed hot semi-arid ecosystem of western India during 2014 and 2015. These genotypes were studied to observe the variability in respect to vegetative growth, flowering and fruit quality attributes under hot semi-arid conditions. The vegetative growth in terms of annual extension growth varied between 35.15-60.00 cm being the lowest in CHESJ-2 and the highest in CHESJ-17. The period of panicle emergence and flowering was recorded in February in almost all the genotypes. Panicle length ranged from 10.12 to 15.12cm. The peak period of fruit set was noticed in between 1st - 3rd week of March, whereas fruit ripening started from 1st week of May and continued up to 4th week of June in different genotypes. Flower length, flower breadth, calyx tube length, calyx tube breadth, petal length, petal breadth, stamen length, style length, ovary length and ovary breadth ranged between 09.23-13.42mm, 09.12-10.46 mm, 7.56-9.07 mm, 4.20-5.17 mm, 4.02-5.24 mm, 3.00-4.09 mm, 5.22-9.07 mm, 7.23-8.94 mm, 3.00-3.63mm and 2.00-2.72mm respectively. Pollen viability and pollen germination ranged from 90.20-98.00 % and 23.00-37.53 % respectively in different genotypes. The maximum fruit yield (59.50 kg/ plant), pulp content (84.17%), TSS (16.60° brix), total sugar (10.23%) was recorded in CHESJ-2, while fruit weight (19.77g) was recorded the maximum in CHESJ-8. Based on the various desired horticultural traits, the genotypes, CHESJ-2 and CHESJ-8 were found to be promising and released as Goma Priyanka and Thar Kranti, respectively at Institute level.**

Key words: *Syzygium cuminii*, Goma Priyanka, Thar Kranti, pollen viability, pollen germination.

INTRODUCTION

The Jamun, botanically known as *Syzygium cuminii* Skeels, is an economically multipurpose tree of the family Myrtaceae. It is one of the important rainfed semi-arid fruit crops, rich in nutrients, hardy in nature, having good processing potential with wider adaptability to grow under varied 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 exhibits 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, precocity in bearing, high yielding, high pulp content and suitability for commercial cultivation at closer spacing. Such variations were observed in terms of flowering, fruiting, yield and fruit quality attributes in jamun, chironji, mahua, tamarind, bael, custard apple and khirni in different agro-climatic conditions (Patel *et al*., 6, Singh *et al.,*9, Singh and Singh, 8, Singh *et al.,* 11, Singh *et al*., 7, Yadav *et al*., 16 , Malik *et al*., 4 and Malik *et al*., 5).The fruit is good source of iron, sugars, minerals, protein and 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 and Singh, 13). The seed powder has also utility as being useful in the treatment of diabetes. The plant can tolerate drought conditions for shorter period 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 to identify suitable genotypes for commercial cultivation.

MATERIALS AND METHODS

The experiment was carried out at 113 m above msl, latitude 22° 41' 38" N and longitude 73° 33' 22" E which 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 32 numbers of rainy days. The mean summer temperature prevails at 32.9^0 C while the mean winter temperature 21.3^0 C indicating that the area falls under hyperthermic soil regime. The mean annual maximum and minimum temperature

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varies from 42 - 44^0 C (May) and 8 - 12^0 C (January), respectively. The experimental soil type was having available N (151.25 kg/ha), P (8.22 kg/ha) and K (143.50kg/ha) and organic carbon (0.33%), while EC and pH, bulk density and hydraulic conductivity of soil were 0.14 dSm^{-1}, 7.50, 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 26 genotypes planted and established through *in-situ* patch budding, was laid out in randomized block design with 3 replications. Observations on plant growth, flowering, fruiting and fruit quality attributes were observed during 2014 and 2015 and mean data were subjected to statistical analysis. Twenty shoots spread over four directions on each tree were tagged and observations on floral traits were recorded. Forty fruits were randomly selected from all the directions of the plant for fruit quality attributes. The pollen viability in different genotypes was tested with two per cent acetocarmine solution. The pollen collected from freshly dehisced anthers was put on the slides and two drops of freshly prepared acetocarmine solution (2%) was added to the slides and was covered gently with a cover slip. The mounted pollens were examined through the microscope after about 15 minutes after proper staining. Pollen which stained deeply, looked normal and symmetrical were considered to be viable and the remaining ones as non-viable (Dhaliwal and Singla, 2). Observations on pollen germinability were recorded by using hanging drop method in 15 per cent sucrose solution after 24 hours. Total soluble solids, vitamin C and sugars were analyzed by the methods as outlined by AOAC (1). The mean data were statistically analyzed as per method suggested by Gomez and Gomez (3).

RESULTS AND DISCUSSION

The data on vegetative growth of different genotypes depicted in Table 1 showed significant differences in respect to annual extension growth of the plants. The annual extension growth varied between 35.15 cm-60.00 cm being the minimum in CHESJ-2, whereas it was recorded maximum in CHESJ-17. 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*.(9) in chironji, Singh *et al*. (15) in khirni and Singh *et al*.(7) in bael under hot semi arid conditions of western India.

In general, peak period of panicle emergence was observed in the month of February in all the genotypes and these genotypes exhibited considerable variations. Panicle initiation started from 1st week of February and continued up to 3rd week of February (Table 1). The peak period of flowering was recorded in February in almost all the genotypes. It was noted in the 1st week of February in CHESJ-1, CHES-2, CHES-3 CHESJ-8, CHESJ-10, CHESJ-13 CHESJ-14, CHESJ-16, CHESJ-17, CHESJ-19, CHESJ-22 CHESJ-23. Flowering took place in 2th week of February in CHESJ-4, CHESJ-6, CHESJ-9, CHESJ-12, CHESJ-15, CHESJ-18, CHESJ-20, CHESJ-21 and CHESJ-24. It was observed in 3rd week of February in CHESJ-5, CHESJ-7and CHESJ-11 (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*., 6), tamarind (Singh *et al*., 11), bael (Singh *et al.,* 7), khirni (Singh *et al*., 15), mahua (Singh and Singh, 8) under different climatic conditions.

Table 1 clearly indicates the significant variation in the length of panicle which varied from 10.12 to 15.50 cm in all the genotypes of jamun. The maximum length was observed in CHESJ-2 (15.50cm) followed by CHESJ-8 (15.12cmm) and CHESJ-17 (15.00cm), while it was recorded minimum in CHESJ-1 (10.12cm).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*. (11) in tamarind. Wide variability in respect to flowering was recorded in jamun and chironji under different climatic conditions (Singh and Singh, 13, Singh *et al*., 9, Singh *et al*., 12). Peak period of fruit setting took place between 1st week of March - 3rd week of March.

Fruits reached at the ripening stage in May and June in different genotypes. The earliest ripening took place in 1st week of May in CHESJ-1 and CHESJ-14. The genotypes CHESJ-4, CHESJ-5, CHESJ-6, CHESJ-8, CHESJ-9, CHESJ-12 andCHESJ-15 ripened at the last in 4th week of June (Table 1). Such variations in fruit ripening have been reported in different fruit crops like chironji (Singh *et al*., 14) and bael (Singh *et al*., 7). 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-8 and the maximum length was recorded in CHESJ-21, whereas calyx tube length ranged between7.56-9.04 mm being the maximum in CHESJ-20. The maximum petal length was recorded in CHESJ-20 and it was noted minimum

Table 1: Plant growth, flowering and fruiting pattern of Jamun genotypes (Mean data 2014 and 2015).

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	Fruit yield/ Plant (kg)	Fruit weight (g)
CHESJ-1	45.70	Spreading	1st week February	2nd week February	1st week March	10.12	1st week May	24.32	17.72
CHESJ-2	35.15	Upright	1st week February	2nd week February	1st week March	15.50	1st week June	59.50	19.54
CHESJ-3	48.10	Semispreading	1st week February	2nd week February	1st week March	14.17	2nd week May	32.65	16.20
CHESJ-4	47.21	Spreading	2nd week February	4th week February	2nd week March	12.32	4th week May	34.28	11.00
CHESJ-5	54.50	Upright	3rd week February	1st week March	3rd week March	10.17	4th week May	28.20	15.93
CHESJ-6	58.24	Semi-spreading	2nd week February	4th week February	2nd week March	12.15	4th week May	29.42	13.22
CHESJ-7	55.21	Upright	3rd week February	1st Week March	3rd week March	14.05	2nd week June	20.95	13.10
CHESJ-8	40.12	Semispreading	1st week February	2nd week February	1st week March	15.12	4th week May	48.65	19.77
CHESJ-9	58.40	Upright	2nd week February	4th week February	2nd week March	12.20	4th week May	23.43	16.24
CHESJ-10	52.10	Semispreading	1st week February	2nd week February	1st week March	13.25	3rd week June	24.28	18.65
CHESJ-11	50.10	Semispreading	3rd week February	1st week March	3rd week March	11.24	3rd week June	27.70	09.90
CHESJ-12	42.80	Upright	2nd week February	4th week February	2nd week March	13.50	4th week May	34.50	17.60
CHESJ-13	45.10	Upright	1st week February	2nd week February	1st week March	14.12	4th week June	19.00	16.85
CHESJ-14	46.20	Spreading	1st week February	2nd week February	3rd week March	13.13	1st week May	19.51	14.59
CHESJ-15	48.20	Semispreading	2nd week February	4th week February	2nd week March	14.22	4th week May	15.83	13.90
CHESJ-16	57.10	Upright	1st week February	2nd week February	1st week March	15.00	4th week June	23.52	13.22
CHESJ-17	60.00	Upright	1st week February	2nd week February	1st week March	12.10	2nd week June	22.94	13.80
CHESJ-18	55.40	Semispreading	2nd week February	4th week February	2nd week March	13.12	2nd week June	15.67	20.95
CHESJ-19	54.20	Semispreading	1st week February	2nd week February	1st week March	14.10	3rd week June	16.00	17.50
CHESJ-20	42.00	Upright	2nd week February	4th week February	2nd week March	11.28	3rd week June	18.54	18.97
CHESJ-21	45.90	Semispreading	2nd week February	4th week February	2nd week March	13.34	2nd week June	19.83	13.84
CHESJ-22	47.00	Semispreading	1st week February	2nd week February	1st week March	11.58	2nd week June	17.51	18.55
CHESJ-23	44.80	Upright	1st week February	2nd week February	1st week March	13.80	3rd week June	15.85	17.89
CHESJ-24	48.10	Upright	2nd week February	4th week February	2nd week March	14.13	2nd week June	14.92	15.57
CHESJ-25	43.00	Semispreading	1st week February	3rd week February	1st week March	13.19	2nd week June	15.90	13.95
CHESJ-26	47.00	Upright	1st week February	3rd week February	3rd week March	13.42	3rd week June	16.17	13.20
CD P=(0.05)	1.24	–	–	–	–	0.23	–	2.32	2.11

Table 2: Floral traits and pollen characters in different jamun genotypes (Mean data 2014 and 2015).

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)	Pollen viability (%)	Pollen germination (%)
CHESJ-1	12.12	10.10	8.23	4.20	4.20	3.02	5.22	3.12	2.10	8.23	91.00	25.00
CHESJ-2	12.30	10.21	8.94	4.54	4.24	3.24	6.54	3.22	2.12	7.58	92.50	26.80
CHESJ-3	11.24	9.21	7.94	4.53	4.23	3.50	6.00	3.10	2.54	7.25	90.20	31.20
CHESJ-4	12.32	9.53	7.56	4.22	4.10	4.00	8.94	3.55	2.70	8.27	95.00	34.00
CHESJ-5	10.27	9.81	7.83	4.20	4.22	3.51	9.05	3.50	2.50	8.94	96.00	33.00
CHESJ-6	11.25	10.23	8.24	4.63	4.55	3.21	8.26	3.60	2.55	8.61	97.00	34.10
CHESJ-7	10.33	10.02	8.40	4.50	4.52	3.53	7.53	3.05	2.50	8.22	96.50	27.07
CHESJ-8	9.23	9.12	8.93	5.09	5.23	3.60	7.02	3.00	2.50	7.50	97.53	37.50
CHESJ-9	13.24	9.36	9.07	5.17	5.21	3.50	8.58	3.50	2.72	7.60	92.00	27.02
CHESJ-10	13.12	9.83	8.53	4.58	5.10	3.64	8.21	3.00	2.52	7.50	94.50	26.50
CHESJ-11	13.27	9.39	9.03	5.10	5.18	3.50	8.57	3.51	2.70	7.62	95.00	23.00
CHESJ-12	12.16	10.10	8.23	4.22	4.09	3.00	5.21	3.13	2.00	8.20	92.00	25.03
CHESJ-13	12.38	10.28	8.97	4.59	4.25	3.22	6.55	3.20	2.12	7.54	90.50	25.10
CHESJ-14	11.29	9.25	7.97	4.52	4.23	3.50	6.00	3.07	2.53	7.23	90.20	31.20
CHESJ-15	12.33	9.58	7.57	4.20	4.02	4.09	8.96	3.52	2.70	8.29	96.00	33.13
CHESJ-16	10.29	9.85	7.84	4.21	4.28	3.53	9.07	3.56	2.55	8.90	97.00	32.00
CHESJ-17	11.27	10.28	8.23	4.67	4.54	3.20	8.25	3.62	2.55	8.60	98.00	36.02
CHESJ-18	10.37	10.46	8.40	4.51	4.53	3.50	7.52	3.04	2.50	8.20	96.50	28.30
CHESJ-19	9.29	9.13	8.97	5.01	5.21	3.62	7.04	3.02	2.50	7.50	94.50	37.50
CHESJ-20	13.23	9.39	9.04	5.11	5.24	3.51	8.56	3.50	2.70	7.61	94.00	24.15
CHESJ-21	13.42	9.85	8.52	4.57	5.00	3.63	8.24	3.09	2.52	7.53	92.50	27.50
CHESJ-22	10.47	9.88	7.80	4.22	4.21	3.51	9.00	3.56	2.59	8.92	96.00	34.10
CHESJ-23	11.29	10.25	8.21	4.63	4.53	3.22	8.28	3.63	2.55	8.63	97.00	37.21
CHESJ-24	10.39	10.14	8.39	4.51	4.50	3.50	7.54	3.10	2.55	8.20	96.50	29.12
CHESJ-25	9.47	9.24	8.94	5.10	5.22	3.63	7.41	3.00	2.56	7.50	98.50	37.53
CHESJ-26	13.29	9.32	9.00	5.11	5.20	3.52	8.52	3.50	2.72	7.60	92.00	25.20
CD P=(0.05)	0.11	0.09	0.07	0.06	0.08	NS	0.05	NS	NS	0.04	1.03	0.53

in CHESJ-15. Wide variation in stamen length was observed which ranged between 5.22-9.07 mm whereas style length ranged between 7.23-8.94 mm being the maximum in CHESJ-5 and the lowest in CHESJ-14. 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*. (7) in bael and Singh *et al.* (12) in chironji under different agro-climatic conditions.

Pollen viability was recorded more than 90 per cent in different genotypes. The maximum pollen viability (98.50 %) was observed in CHESJ-25 and it was noted the least in CHESJ-3 (90%). Pollen germination was poor irrespective of the genotypes, but showed significant variation (Table 2). The maximum pollen grain germination varied between 24.00-37.52 per cent and it was recorded the maximum in CHES J-9 and the lowest in CHESJ-20. Differences in pollen germination may be due to varying percentage of pollen viability in different genotypes. Dhaliwal and Singla (2) and Singh *et al*. (10) also recorded wide variation in reproductive attributes of guava and jamun under various climatic conditions.

Variability recorded in yield and fruit weight is presented in Table 1. Results of study revealed significant differences in yield and fruit weight among the genotypes. Yield per plant was recorded

the maximum in CHESJ-2 (59.50kg/ plant) followed by CHESJ-8 (48.65kg/plant), CHESJ-4 (34.50kg/ plant), CHESJ-5 (34.28kg/plant), CHESJ-3 (32.65kg/ plant), and it was recorded the lowest in CHESJ-24 (14.32kg/plant). The maximum fruit weight was recorded in CHESJ-18 (20.95g) followed by CHESJ-2 (19.70g), CHESJ-2 (19.54g) and CHESJ-20 (18.97g), while it was recorded lowest in CHESJ-11 (9.90g). Variation in fruit yield and weight in various fruit crops have been reported by Singh *et al.* (7) in bael and Singh *et al.* (14) in chironji under rainfed semi-arid conditions of western India. Pulp content was recorded maximum in CHESJ-24 (84.88%), closely followed by CHESJ-2 (84.17%), CHESJ-8 (83.25%), CHESJ-11 (82.83%), CHESJ-7 (81.68%) and CHESJ-19 (80.00%), it was found to be the minimum in CHESJ-10 (70.91%).

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 13.10 to 16.60^{0}Brix and 8.30 to 10.02%, respectively in different genotypes. The maximum total soluble solids was found in CHESJ-2 (16.60^{0}Brix), closely followed by CHESJ-8 (15.15 ^{0}brix) and CHESK-7 (15^{0}Brix), it was found least in CHESJ-10 (13.02^{0}Brix). The highest total sugar content was also recorded in CHESJ-2 (10.02%), followed by CHESJ-1 (9.90%) and CHESJ-21 (8.87%) and it was recorded least in CHESJ-1(8.30%). Vitamin C content was

Table 3: Fruit morphological and quality attributes of Jamun genotypes (Mean data 2014 and 2015).

Genotype	Fruit shape	Fruit length (cm)	Fruit breadth (cm)	Pulp weight (g)	Pulp percent	TSS (Degree Brix)	Acidity (%)	Total sugar (%)	Reducing sugar (%)	Vitamin C (mg/100g)
CHESJ-1	Oblong	3.12	2.14	13.60	76.83	14.15	0.40	9.90	3.90	42.10
CHESJ-2	Oblong	3.23	2.22	16.75	84.17	16.60	0.39	10.02	3.85	43.43
CHESJ-3	Oblong	2.98	2.22	13.40	82.71	13.20	0.38	9.02	3.83	42.13
CHESJ-4	Ovoid	2.16	2.11	08.20	74.00	13.42	0.37	9.50	3.95	43.07
CHESJ-5	Oblong	2.50	2.13	12.70	79.87	14.50	0.41	8.30	3.50	44.00
CHESJ-6	Oblong	2.50	2.06	10.18	77.12	13.10	0.42	8.83	3.69	43.00
CHESJ-7	Ovoid	2.19	2.13	10.71	81.68	15.00	0.44	8.80	3.78	41.11
CHESJ-8	Oblong	3.09	2.16	16.43	83.25	15.15	0.40	10.00	3.84	46.60
CHESJ-9	Oblong	2.93	2.02	12.22	74.81	14.13	0.43	9.75	3.92	42.12
CHESJ-10	Oblong	3.00	2.03	13.19	70.91	13.02	0.38	8.70	3.51	41.05
CHESJ-11	Oblong	1.98	2.01	08.20	82.83	13.10	0.35	9.43	3.92	40.45
CHESJ-12	Oblong	3.08	2.11	13.34	75.57	14.50	0.39	9.65	4.50	39.45
CHESJ-13	Oblong	2.96	2.09	13.25	78.34	14.07	0.44	9.80	3.98	40.07
CHESJ-14	Oblong	2.70	2.10	11.67	79.50	13.04	0.43	8.92	3.75	38.10
CHESJ-15	Oblong	2.81	2.00	11.08	79.14	13.12	0.42	8.65	3.76	40.07
CHESJ-16	Oblong	2.14	2.09	10.30	78.03	13.12	0.39	8.74	3.80	41.12
CHESJ-17	Ovoid	2.22	2.18	11.00	79.71	13.50	0.38	8.97	3.89	42.09
CHESJ-18	Oblong	3.14	2.19	15.60	74.46	14.54	0.39	9.13	4.20	43.50
CHESJ-19	Oblong	2.98	2.14	14.00	80.00	14.10	0.43	9.22	4.42	43.10
CHESJ-20	Oblong	3.14	2.10	14.20	74.93	14.12	0.41	9.11	4.10	41.00
CHESJ-21	Oblong	1.99	2.12	10.10	72.92	13.13	0.47	8.87	3.87	41.42
CHESJ-22	Oblong	3.10	2.15	13.29	71.15	14.10	0.42	9.44	4.24	40.23
CHESJ-23	Oblong	2.98	2.18	14.35	79.93	14.40	0.43	9.83	4.50	38.82
CHESJ-24	Oblong	2.80	2.19	13.20	84.88	14.50	0.41	9.62	4.24	38.10
CHESJ-25	Oblong	2.86	2.11	10.53	75.26	13.17	0.42	8.80	3.74	38.30
CHESJ-26	Oblong	2.19	2.18	10.50	79.54	13.10	0.41	8.63	3.80	38.10
CD P=(0.05)	–	0.32	0.09	1.11	2.11	0.20	0.01	0.43	0.32	1.10

found to be maximum in CHESJ-18 (43.50mg/100g) closely followed by CHESJ-5 (44.00 mg/ 100g) and CHESJ-2 (43.43 mg/ 100g), it was noted the lowest in CHESJ-26 (38.00 mg/ 100g). Malik *et al.* (4) and Singh *et al*. (15) have also recorded the remarkable variability in relation to fruit quality attributes of khirni. Based on the horticultural traits studied, the genotypes, CHESJ-2, CHESJ-8, CHESK-11 and CHESJ-24 were found to be promising under rainfed hot semi-arid conditions of western India. The genotype CHESJ-2 and CHESJ-8 were released as variety namely Goma Priyanka and Thar Kranti for commercial exploitation.

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