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Genetic divergence in *chironji* (*Buchanania lanzan*) under semi-arid ecosystem of western India

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ABSTRACT

The present study was undertaken to evaluate the performance of 30 genotypes of *chironji* (*Buchanania lanzan* spreng) at Experimental Farm of Central Horticultural Experiment Station (CIAH), Vejalpur, Panchmahals (Godhra), Gujarat under rainfed hot semi-arid ecosystem of western India during the years 2011-2013. The results of study revealed that the different genotypes of chironji exhibited considerable variation for vegetative, floral, yield and physicochemical characters. The vegetative growth in terms of plant height, rootstock girth, plant spread (East-West) and plant spread (North-South) varied between 5.96-1.63m, 23.99-53.38cm, 1.40-5.10 m and 1.50-5.38 m, respectively. Time of flowering and fruit set ranged between 1st week February- 3rd week February and 3rd week February- 2nd week March, respectively. Maximum panicle length (35.13 cm) was noted in CHESC 1, while number of fruits per panicle was recorded highest in CHESC 7. Peak period of ripening in all the genotypes was recorded in May. Fruit yield, fruit weight, pulp per cent, TSS, acidity, total sugar and vitamin C varied from 1.00 kg-11.00 kg/plant, 0.94g-1.34g, 43.52-63.06%, 19.05-23.90^{0}brix,1.00-1.34%,13.01-15.51% and 42.24-64.09%, respectively. Stone weight, shell weight, kernel weight and protein content ranged between 0.38-0.68g, 0.27-0.55 g, 0.08-0.15g and 23.53-31.36%, respectively. Based on the horticultural traits studied, the genotypes, CHESC7, CHESC2, CHESC 4 and CHESC11 were found to be promising under rainfed hot semi-arid conditions of western India. The genotype CHESC 7 was released as variety named as Thar Priya.

Key words: Chironji, Flowering, Genotypes, Heterozygous, Kernel, Panicles, Protein

Chironji (*Buchanania lanzan* Spreng) of family Anacardiaceae, an under utilized fruit crop, assumes great significance due to its diversified uses and capacity to withstand adverse climatic conditions. Hot semi-arid zone is characterised by the low annual rainfall (750 mm) and the rainy spells are confined to 3 wet months (July to September) and the remaining parts of the year are dry months. The rains are also erratic and often come in a few storms of short duration which results in great runoff without charging the soil moisture profile resulting into water stress in soil during major parts of the year. Arid and semi-arid regions have peculiar eco-climatological features in which several major agronomical crops fail to sustain. At present, Chironji is grown in the forest and gives monitory reward to the tribal community of the country particularly in Gujarat, Maharashtra, Chhattisgarh, Madhya Pradesh and Jharkhand. It is very hardy and thrives well on rocky and gravelly soils. The flesh of ripe fruit is very palatable and the oily kernel is the most important part, which is used in preparation of sweets (Munde *et al*. 2003). The kernel is highly nutritious and rich in protein and yields sweet oil, which can be used to substitute olive and almond oil (Kumar *et al*. 2012). It is a highly heterozygous, cross-pollinated fruit crop and as such seedlings exhibit a wide range of variations, which aids in the selection of the superior desirable genotypes. Elite genotypes were collected from the existing population of chironji based on the horticultural traits and evaluated under field condition to develop chironji variety having earliness, short stature, precocious bearer, high yielder, high kernel content and suitable for high density planting under semi-arid conditions of western India (Singh *et al*. 2010a and Singh *et al*. 2010b). Variations were observed in flowering, fruiting, yield and fruit quality attributes in jamun, chironji and tamarind under Gujarat conditions (Patel *et al*. 2005, Singh *et al.* 2006, Singh *et al.* 2007 and Singh and Singh 2012). Present investigation was carried out to find out variability in plant growth, flowering, fruiting and fruit quality attributes of different genotypes of chironji, so that the suitable variety could be developed under crop improvement programme.

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

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characterized by hot semi-arid climate. The annual rainfall was mainly confined to three months (July- September) and actual mean precipitation was about 750 mm. The mean summer temperature was 32.9^0 C while the mean winter temperature is 21.3^0 C indicating that the area falls under hyperthermic soil regime.The mean annual maximum and minimum temperature varied from 42 - 44^0 C and 6 - 9^0 C in January, 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, and falls under semi-arid hot climate.

A total of 30 genotypes were established through *in-situ* softwood grafting during 2004. The experiment was laid out in randomized block design with 3 replications, observations on plant growth, flowering, fruiting and fruit quality attributes were observed during 3 consecutive years (2011, 2012, 2013) and mean data were presented in the tables. Twenty shoots spread over four directions on each tree were tagged and detail observations on floral traits were recorded. The pollen viability in different genotypes was tested with 2% acetocarmene solution. The pollen from freshly dehisced anthers was put on the slides. About 2 drops of freshly prepared 2% acetocarmine solution was added to the slides and was covered gently with a cover slip. The mounted pollens were examined under the microscope after about 15 min, when they had attained 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 2003). Observations on pollen germinability were recorded by using hanging drop method in 15% sucrose solution after 24 hours. Fruits were randomly selected from all the directions of the plant for fruit quality attributes. Total soluble solids, protein, vitamin C and sugars were analyzed by the method by AOAC (1980). The mean data were statistically analyzed as per method given by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

The data on vegetative growth of different varieties depicted in Table 1 showed significant differences in respect of their vegetative characters. The plant height ranged between 1.63-5.96 meter being highest in CHESC 11, it was recorded least in CHESC 20. The differences in root stock girth was significant, it was found to be highest in CHESC

Table 1 Plant growth pattern and bud development in different chironji genotypes (Mean data of 2011, 2012 and 2013)

Genotype	Plant height (m)	Root stock girth (cm)	Plant spread (m)		Tree form	Leaf area (cm^2)	Time taken for bud development (days)
			(N-S)	(E-W)			
CHESC 1	3.55	43.40	2.59	2.69	semi spreading	106.97	17.66
CHESC 2	3.05	50.53	2.37	2.41	Semi spreading	116.25	19.66
CHESC 3	1.95	30.60	1.50	1.90	semi spreading	115.35	18.33
CHESC 4	3.60	37.98	2.90	2.46	semi spreading	123.72	16.66
CHESC 5	3.00	46.89	2.86	2.80	spreading	97.58	16.66
CHESC 6	3.25	50.99	2.79	2.40	spreading	97.90	16.33
CHESC 7	3.43	53.38	2.90	2.48	Spreading	122.02	17.33
CHESC 8	3.33	53.00	2.66	1.67	upright	139.18	18.33
CHESC 9	4.90	49.86	3.40	3.34	upright	131.61	19.66
CHESC 10	4.85	38.96	3.80	3.56	upright	138.11	16.00
CHESC 11	5.96	27.33	4.36	4.78	Semi Spreading	123.62	18.33
CHESC 12	3.8o	46.68	3.79	3.97	Semi Spreading	124.52	18.00
CHESC 13	2.76	35.69	2.40	2.00	semi spreading	105.34	17.33
CHESC 14	3.89	24.88	3.58	3.01	Semi Spreading	118.92	18.33
CHESC 15	4.45	43.69	3.98	3.96	upright	108.32	18.00
CHESC 16	5.57	32.77	4.38	3.90	upright	117.54	20.20
CHESC 17	3.05	23.99	2.47	2.45	upright	119.18	18.20
CHESC 18	5.13	45.33	4.76	4.59	spreading	123.24	17.20
CHESC 19	5.50	25.96	5.38	5.48	spreading	124.50	20.30
CHESC 20	1.63	33.89	1.50	1.79	Semi Spreading	128.24	18.20
CHESC 21	4.73	50.10	4.48	4.58	upright	121.15	17.33
CHESC 22	4.35	52.60	3.50	3.12	upright	125.30	20.00
CHESC 23	4.16	48.90	3.39	3.34	upright	125.29	18.00
CHESC 24	3.04	38.66	2.58	2.54	upright	118.29	17.40
CHESC 25	5.68	50.30	4.94	2.48	upright	123.80	20.25
CHEC 26	3.98	46.36	2.76	2.69	upright	127.32	18.20
CHESC 27	4.95	49.45	4.00	3.53	upright	126.30	17.00
CHESC 28	4.32	38.92	3.00	3.11	upright	130.35	19.66
CHESC 29	4.46	49.44	3.06	2.90	upright	126.34	21.00
CHESC 30	4.91	52.38	3.45	3.10	upright	125.30	17.00
CD (P= 0.05)	0.87	3.21	0.58	0.33		3.21	1.12

7 (53.38 cm) followed by CHESC 8 (53.00 cm), while it was noted minimum in CHESC 23 (23.99 cm). The plant spread (E-W-5.38 m and N-S-5.10m) was recorded maximum in CHESC 19, followed by CHESC 25 and CHESC 11. The difference in vegetative growth among the varieties may be due to inherent characters of individual genotypes and their acclimatization to varied agro-climatic conditions. The dwarfness is the desirable characters for the high density planting by accommodating more number of plants per unit area which ultimately enhanced the productivity. Similar results with respect to vegetative characters were reported by Singh *et al.* (2014) in bael under hot semi-arid conditions of western India.

The data on the flowering pattern of different genotypes depicted in Table 2 showed considerable differences. The earliest peak period of flowering (1st week of February) was observed in CHESC 1, CHESC 5, CHESC 10, CHESC 15, CHESC 17, CHESC 19 and CHESC 22, while it was noted as late as 4th week of February in CHESC 13. Fruit set started by the third week of February and completed by the second week of March in different genotypes. Panicle length varied from 14.22 to 35.13 cm in different genotypes and it was found to be maximum in CHESC 1, followed by CHESC 12, CHESC 7, CHESC 6, CHESC 8, CHESC 2, CHESC 15, CHESC 29 and CHESC 30, while CHESC 18 recorded the least panicle length. There was a marked variation in number of fruits per panicle in most of the genotypes and CHESC 12 recorded maximum fruit per panicle (37.46) followed by CHESC 1, CHESC 7, CHESC 6 and CHESC 8, while it was found least in CHESC 18 (15.12). Number of fruits/panicle was found to be significantly associated with panicle length and it may be observed while selecting elite genotypes. Meghwal and Azam (2004) and Singh and Singh (2005) also recorded remarkable variability in aonla and mahua genotypes under Rajasthan and Gujarat conditions, respectively. Wide variability in respect of panicle emergence and period of flowering was recorded in mango, jamun and chironji under different climatic conditions (Singh 2002, Hoda *et al.* 2003, Singh and Singh 2005, Singh *et al*. 2006). Variability in fruit set was also recorded in jamun genotypes (Singh *et al*. 2007).

Chironji genotypes differed in their time requirement to complete the bud development and it ranged from 16-21 days being highest in CHESC 29, closely followed by

Table 2 Reproductive attributes of different chironji genotypes (Mean data of 2011, 2012 and 2013)

Genotype	Flowering time	Time of fruit set	Panicle length (cm)	Fruits/ panicle	Pollen viability (%)	Pollen germination (%)
CHESC 1	1st week February	3rd week February	35.13	36.25	64.21	26.20
CHESC 2	2nd week February	4th week February	25.29	26.45	63.30	28.45
CHESC 3	2nd week February	4th week February	15.32	18.08	66.20	24.15
CHESC 4	2nd week February	4th week February	20.10	22.15	64.06	25.95
CHESC 5	1st week February	3rd week February	25.15	26.10	65.02	26.65
CHESC 6	3rd week February	1st week March	26.10	27.08	57.15	26.33
CHESC 7	2nd week February	4th week February	27.15	28.10	65.90	31.49
CHESC 8	3rd week February	1st week March	26.10	27.03	58.05	27.15
CHESC 9	3rd week February	1st week March	18.15	20.13	61.03	26.25
CHESC 10	1st week February	4th week February	17.33	18.24	63.02	22.51
CHESC 11	2nd week February	4th week February	20.12	21.51	63.51	24.15
CHESC 12	3rd week February	1st week March	32.08	37.46	62.23	29.32
CHESC 13	4th week February	2nd week March	20.10	21.08	64.55	27.10
CHESC 14	2nd week February	4th week February	17.08	18.38	64.25	24.17
CHESC 15	1st week February	3rd week February	22.03	23.12	60.52	24.45
CHESC 16	3rd week February	1st week March	17.17	18.09	58.28	27.17
CHESC 17	1st week February	4th week February	15.10	16.08	61.53	26.22
CHESC 18	2nd week February	1st week March	14.22	15.12	63.72	22.52
CHESC 19	1st week February	4th week February	17.53	18.03	61.53	24.15
CHESC 20	2nd week February	4th week February	18.03	19.85	62.20	29.32
CHESC 21	2nd week February	4th week February	16.07	18.18	64.56	27.10
CHESC 22	1st week February	4th week February	15.23	16.47	64.25	24.17
CHESC 23	3rd week February	1st week March	19.10	20.39	65.49	24.39
CHESC 24	2nd week February	1st week March	18.22	19.52	63.22	24.15
CHESC 25	2nd week February	4th week February	17.14	18.02	65.04	29.31
CHEC 26	2nd week February	4th week February	18.54	19.65	61.54	27.09
CHESC 27	2nd week February	1st week March	19.23	20.12	62.55	24.14
CHESC 28	2nd week February	1st week March	18.60	20.07	64.60	27.17
CHESC 29	2nd week February	4th week February	21.12	23.16	56.12	24.13
CHESC 30	3rd week February	2nd week March	21.25	22.49	58.16	23.10
CD (P= 0.05)			3.24	2.12	1.12	2.42

CHESC 16, CHESC 19 and CHESC 25 (Table 2). The variability in respect of flowering period has also been reported by Singh (2002), Dobral and Misra (2007), and Singh *et al*. (2008) in mango, litchi and tamarind.

Maximum pollen viability (66.20%) was observed in CHESC 3, which was closely followed by CHESC 5, CHESC 7 and CHESC 25, however minimum pollen viability was observed in CHESC 8 (58.05%). Kumar *et al.* (2004) reported that pollen viability ranged from 74.90-94.22% in different peach cultivars under Uttarakhand conditions. Singh *et al*. (2004) obtained 75.60-88.00 percent pollen viability in different pear cultivars. Pollen germination was poor irrespective of the genotypes (Table 2). The maximum pollen grain germination was recorded in CHESC 7 (31.49%) closely followed by CHESC 12, CHESC 20 and CHESC 25, while it was found to be least in CHESC 10 (22.51%). Differences in pollen germination may be due to varying percentage of pollen viability in different genotypes. Kumar *et al*. (2004) reported that pollen germination ranged from 62.12-78.23% in different peach cultivars under Uttaranchal conditions. Pollen grain viability ranged from 91.05-97.91% among different genotypes of pomegranate (Sharma and Bist 2003). Dhaliwal and Singla (2003), Hoda *et al*. (2003), Singh *et al*. (2004) and Singh and Singh (2005) recorded wide variation in reproductive attributes of guava, mango, tamarind, and *mahua* (*Bassia latifolia* Roxb.), respectively, under various climatic conditions.

The range of variation in leaf area was 97.58-139.18 cm^2 and CHESC 8 recorded maximum leaf area followed by CHESC 10, CHESC 28, CHESC 9, CHESC 26 and CHESC 23. Earliest ripening (3rd week of April) was recorded in CHESC 7, while it was noted late (2nd week of May) in CHESC 2, CHESC 3, CHESC 6, CHESC 9, CHESC 13, CHESC 17, CHESC 24 and CHESC 28 and CHESC 30.

All genotypes were regular bearer. The highest fruit yield (11.00 kg) per plant was found in CHESC7 closely followed by CHESC 2, CHESC 8 and CHESC 3. The study was undertaken to investigate the nature and extent of variability present in bael and high degree of variability was observed with regard to fruit yield, fruit size and fruit weight (Singh *et al.* 2014). Variability recorded in physical and biochemical characters in chironji fruits are presented in Table 3. The fruit weight ranged from 0.94 – 1.34g and it was found to be highest in CHESC 1, followed by CHESC

Table 3 Ripening time, fruit yield and quality attributes of different chironji genotypes (Mean data of 2011, 2012 and 2013)

Genotype	Ripening time	Fruit yield per plant	Fruit weight (g)	Pulp weight (g)	Pulp percent	TSS (%)	Acidity (%)	Total sugar (%)	Reducing sugar (%)	Vitamin C (mg/100g)
CHESC 1	1st week May	5.00	1.34	0.65	48.50	22.21	1.13	15.15	4.13	51.53
CHESC 2	2nd week May	9.50	1.32	0.77	58.33	21.20	1.21	14.42	2.99	46.54
CHESC 3	2nd week May	5.50	1.32	0.73	55.34	20.20	1.30	14.15	2.82	58.05
CHESC 4	1st week May	4.00	1.33	0.67	50.38	20.57	1.00	14.25	3.12	57.92
CHESC 5	1st week May	3.00	1.24	0.67	54.03	19.29	1.23	13.20	3.21	60.53
CHESC 6	2nd week May	5.80	1.11	0.70	63.06	21.84	1.20	14.62	2.16	42.24
CHESC 7	3rd week April	11.00	1.15	0.69	57.56	23.90	1.24	13.06	6.67	48.70
CHESC 8	1st week May	7.00	1.00	0.62	62.00	23.04	1.12	15.51	3.64	47.05
CHESC 9	2nd week May	5.50	0.99	0.50	50.51	21.01	1.10	14.13	3.44	47.54
CHESC 10	4th week April	4.00	0.94	0.47	50.00	19.05	1.23	13.01	3.30	55.33
CHESC 11	1st week May	5.90	1.08	0.47	43.52	21.03	1.34	14.65	3.25	61.32
CHESC 12	1st week May	2.00	1.11	0.60	54.05	21.08	1.00	14.64	2.92	55.21
CHESC 13	2nd week May	3.00	1.22	0.60	49.18	20.02	1.24	13.62	3.18	57.06
CHESC 14	1st week May	4.60	1.31	0.64	48.85	20.03	1.10	13.52	4.35	56.07
CHESC 15	1st week May	2.20	1.08	0.58	53.70	19.48	1.29	13.19	3.51	64.09
CHESC 16	1st week May	3.00	1.31	0.77	58.78	22.04	1.30	15.12	4.12	45.35
CHESC 17	2nd week May	3.25	1.33	0.83	62.41	20.02	1.00	14.12	3.44	47.23
CHESC 18	1st week May	4.55	1.33	0.80	60.15	19.81	1.10	13.50	3.33	49.31
CHESC 19	1st week May	2.00	1.21	0.75	61.98	19.92	1.23	13.54	3.42	42.26
CHESC 20	1st week May	1.50	1.17	0.64	54.70	22.08	1.34	15.15	4.13	49.09
CHESC 21	1st week May	1.00	1.20	0.69	57.50	21.03	1.00	14.62	4.03	56.34
CHESC 22	1st week May	1.10	1.23	0.75	60.65	21.25	1.00	14.71	4.07	57.95
CHESC 23	1st week May	1.00	0.97	0.60	60.98	21.46	1.11	14.75	4.10	52.33
CHESC 24	2nd week May	1.20	1.00	0.55	55.00	21.29	1.23	14.64	3.93	54.62
CHESC 25	1st week May	1.50	1.12	0.70	62.50	21.36	1.32	14.71	3.94	58.39
CHEC 26	1st week May	2.50	1.19	0.75	63.03	19.44	1.00	13.42	3.70	60.32
CHESC 27	1st week May	1.80	1.17	0.66	56.41	19.85	1.11	13.53	3.71	52.63
CHESC 28	2nd week May	1.00	1.21	0.71	58.68	20.08	1.29	14.14	3.91	42.96
CHESC 29	1st week May	1.00	1.23	0.70	56.91	22.17	1.31	15.13	4.15	42.39
CHESC 30	2nd week May	1.20	1.29	0.76	58.91	21.46	1.09	14.74	3.88	42.85
CD (P=0.05)		0.31	0.09	0.02	1.22	0.75	NS	0.62	0.13	1.32

17, CHESC 2, CHESC 3 and CHESC 4. The fruits of CHESC 6 recorded maximum pulp per cent (63.06%) and that of 'CHEC 11' the lowest (43.52%). Chironji fruits are also rich source of total soluble solids, sugars and vitamin C and these values varied significantly in different genotypes. total soluble solids and total sugar content of fruits ranged from 19.05 to 23.90^0 Brix, 13.01 to 15.51%, respectively, in different genotypes. The highest Total soluble solids (TSS) was recorded in CHESC 7 (23.90^0 Brix), followed by CHESC 8 (23.04^0 Brix) and CHESC 1 (22.21^0 Brix). Maximum total sugar content was found in CHESC 8 (15.51%), closely followed by CHESC 1 (15.15%) and CHESC 29 (15.13%). Vitamin C content was found to be highest in CHESC 15 (64.09 mg/ 100g) closely followed by CHESC 11(61.32 mg/ 100g), CHESC 5 (60.53 mg/ 100g), and CHESC 26 (60.32 mg/100g), whereas, CHESC 6 recorded the lowest (42.24 mg/100g). Ram and Singh (2003), Machewade *et al*. (2003) and Singh *et al.* (2010b) have also recorded the variation in fruit quality attributes in different bael and chironji genotypes.

It is evident from the data (Table 4) that the values of stone characters also varied significantly in different genotypes. The stone weight varied from 0.38 g to 0.68 g in different genotypes being highest in CHESC 1 and CHESC 14, it was closely followed by CHESC 4 (0.67g) and CHESC 13 (0.63g)**.** Similarly shell per cent also ranged from 68.18 to 86.44 and it was highest in CHESC 11 followed by CHESC 13 (84.13%) and CHESC 5 (74.14%)**.** Kernel weight was noted maximum in CHES 5 and CHES C 27 (0.15 g) closely followed by CHESC 1, CHESC 6 and CHESC 14**.** The chironji seed kernel is highly nutritious and rich in protein and yields sweet oil, which can be used to substitute olive and almond oil. The chemical composition of kernel also showed variation in terms of protein content (Table 4). The highest protein content was recorded in CHESC 7 (31.36%), it was closely followed by CHESC 2, CHESC 19 and CHESC 20**.** The remarkable variability was observed in relation to nut and kernel characters in hezalnut, walnut and apricot (Sharma and Sharma 2004, Sharma and Das 2003 and Zaffar *et al*. 2004). Based on the horticultural traits studied, the genotypes, CHESC 7, CHESC 2, CHESC 4 and CHESC 11 were found to be promising under rainfed hot semi-arid conditions of western India. The genotype CHESC 7 was released as variety named as Thar Priya.

Table 4 Stone and kernel quality attributes of different *chironji* genotypes (Mean data of 2011, 2012 and 2013)

Genotype	Stone weight (g)	Stone length (cm)	Stone width (cm)	Shell weight (g)	Shell percent	Kernel weight(g)	Kernel (%)	Kernel protein (%)
CHESC 1	0.68	1.01	1.01	0.54	79.41	0.14	20.59	28.50
CHESC 2	0.54	1.02	0.90	0.43	79.63	0.11	20.37	30.70
CHESC 3	0.58	1.01	0.91	0.48	82.76	0.10	17.24	29.53
CHESC 4	0.67	1.01	1.01	0.55	82.09	0.12	17.91	26.34
CHESC 5	0.58	0.99	0.97	0.43	74.14	0.15	25.86	26.00
CHESC 6	0.44	0.87	0.88	0.30	68.18	0.14	31.82	28.14
CHESC 7	0.53	0.84	0.86	0.41	78.09	0.12	21.90	31.36
CHESC 8	0.40	0.83	0.87	0.30	75.00	0.10	25.00	26.77
CHESC 9	0.48	0.84	0.86	0.39	81.25	0.11	22.92	24.87
CHESC 10	0.50	0.85	0.85	0.39	78.00	0.09	18.00	27.00
CHESC 11	0.59	0.86	0.87	0.51	86.44	0.09	15.25	25.10
CHESC 12	0.53	0.87	0.87	0.40	75.47	0.13	24.53	24.00
CHESC 13	0.63	0.86	0.86	0.53	84.13	0.10	15.87	23.53
CHESC 14	0.68	0.88	0.87	0.54	79.41	0.14	20.59	25.90
CHESC 15	0.51	0.85	0.86	0.43	84.31	0.08	15.69	26.90
CHESC 16	0.53	1.01	0.89	0.40	75.47	0.13	24.53	26.32
CHESC 17	0.53	0.98	0.97	0.45	84.91	0.08	15.09	26.94
CHESC 18	0.52	0.87	0.85	0.42	80.77	0.10	19.23	28.31
CHESC 19	0.46	0.97	0.93	0.37	80.43	0.09	19.57	30.33
CHESC 20	0.54	0.86	0.88	0.43	79.63	0.11	20.37	30.28
CHESC 21	0.53	0.86	0.87	0.41	77.36	0.12	22.64	29.21
CHESC 22	0.47	0.84	0.83	0.36	76.60	0.11	23.40	28.37
CHESC 23	0.38	0.87	0.86	0.27	71.05	0.11	28.95	25.00
CHESC 24	0.46	0.98	0.84	0.35	76.09	0.11	23.91	24.94
CHESC 25	0.43	0.91	0.86	0.31	72.09	0.12	27.91	24.54
CHEC 26	0.43	0.92	0.89	0.30	69.77	0.13	30.23	25.24
CHESC 27	0.53	0.84	0.86	0.38	71.70	0.15	28.30	28.28
CHESC 28	0.51	0.86	0.87	0.42	82.35	0.09	17.65	29.29
CHESC 29	0.54	0.85	0.86	0.44	81.48	0.10	18.52	28.28
CHESC 30	0.52	0.88	0.87	0.41	78.85	0.11	21.15	24.94
CD (P= 0.05)	0.03	0.02	0.03	0.01	0.39	0.02	0.19	0.23

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