



[Research Article]

Performance of aonla cultivars under humid tropical conditions of Western ghats

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ABSTRACT

Seven cultivars of aonla (*Emblica officinalis* Gaertn) were evaluated under humid tropical conditions at Central Horticultural Research Station (IIHR), Chettalli (Karnataka) for 3 years during 2010 to 2012 for growth and yield. Highest plant height (6.32 m), rootstock circumference (75.10 cm), scion circumference (74.24 cm) and plant spread (N-S) (6.18m) was recorded in cv. BSR-1 followed by cv. Kanchan. The highest number of fruits (798) was recorded in cv. Chakaiya followed by cv. Krishna (649), while fruit yield was highest in cv. Chakaiya (26.78 kg/plant) and cv. Krishna (26.34 kg). Highest fruit weight (40.57 g) was recorded in cv. Krishna followed by NA-6 (37.72 g). The lowest fruit weight was recorded in BSR-1 (18.59g). The pulp percent was highest in cv. NA-7 (95.50 %) and cv. Chakaiya (95.33 %). T.S.S was highest in cv. BSR -1 (11.5° Brix) followed by cv. Kanchan (9.87° Brix). Ascorbic acid, acidity and sugar percent was higher in cv. BSR-1 than other cultivars. The cv. BSR-1 was found better for growth and fruit quality parameters while yield and fruit size was higher in cvs. Chakaiya and Krishna.

KEY WORDS: Aonla, *Emblica officinalis*, performance evaluation, western ghats

Aonla or Indian gooseberry (*Emblica officinalis* Gaertn) is an indigenous fruit of India. It is a deciduous tree of the Euphorbiaceae family. It grows mostly in arid and semi-arid region of the country due to its hardy nature, drought tolerance, prolific bearing and high remuneration with much less care. Fruits contain high amounts of ascorbic acid, flavonoids, kaempferol, ellagic acid and gallic acid. Its cultivation is common in drier region of north and central India, particularly in U.P., M. P., Rajasthan and Maharashtra. Aonla cultivation is also spreading rapidly in the semi-arid regions of Gujarat, Andhra Pradesh, Tamil Nadu and Karnataka during last few decades. Aonla is found growing in wide range of climatic conditions in different parts of country. It thrives well under arid and sub arid conditions but plants are also found growing in high rainfall areas. The initial study conducted at revealed that the Aonla varieties performed well at humid conditions of Coorg region (Sudhir Kumar *et. al*, 2011.) A number of selections and cultivars were evolved during the last four to five decades, but meagre information is available on the proximate yield and physico chemical properties of the varieties under humid tropic regions of Western ghats.

MATERIALS AND METHODS

Present investigation was carried out at Central Horticultural Experiment Station, Chettalli, Kodagu District, Karnataka during the year 2010-12 to study the growth and yield performance of 10 year-old trees of aonla cultivars namely Kanchan, NA-6, NA-7, NA-10, Krishna, Chakaiya, BSR-1. Chettalli is situated in the Western Ghats of peninsular India with an elevation of about 1000 m above MSL. The area is classified as hilly humid tropic region. The mean annual rainfall is about 1500 mm (Fig 1). The grafted plants of different aonla cultivars were planted during 2002 in a square system at 6 x 6 m spacing. The experiment was layout in randomized block design with three replications having four plants each replication. The orchard was maintained under recommended package of practices. Observations were recorded on plant height, plant girth, plant spread, fruit number, yield (kg/plant), fruit weight, fruit size, fruit volume, pulp weight, stone weight, total soluble solids, acidity, ascorbic acid, reducing sugars and total sugars. The fruit were harvested in the month of September in each year for analysis. Ten mature fruits from each tree were taken randomly for physico-chemical analysis. The samples

were analysed as per standard AOAC(1980) methods with modifications. The data were analysed statistically.

RESULTS AND DISCUSSION

The growth data of aonla cultivars revealed that the maximum plant height (6.32 m) was recorded in cv. BSR-1 while lowest plant height was recorded in cv. Chakaiya (3.71 m). The rootstock diameter, scion diameter were also higher in cv. BSR-1 than other cultivars (Table1). The data on plant spread (North-South) was highest in cv. BSR-1 (6.43m) while it was lowest (2.74m) in cv. Chakaiya followed by cv. NA-6 (2.86 m). The plant spread (East-West) showed similar tend and it was highest in cv. BSR-1 (6.21m) and lowest in cv. Chakaiya (2.64 m).The growth data revealed that the popular varieties of North India produced lesser vegetative growth as compared to cv. BSR-1 under the humid conditions of Western Ghats. The plant mortality was also higher in these varieties as compared to cv. BSR-1. This may be due to wet foot condition and high rainfall in the region.

The yield data of aonla varieties revealed that average highest numbers of fruits (798) were recorded in cv. Chakaiya followed by cvs. Krishna (649) and BSR-1 (625). The lowest number of fruits was recorded in cv. NA-6 which was 320. The data also revealed that all the varieties showed regular bearing. Chakaiya showed higher yield in second year of observation and moderate yield in first and third years of observation. The fruit yield was highest in cvs. Chakaiya (26.78kg/plant) and Krishna (26.34kg/plant) and it was lowest in cvs. BSR-1 (11.53 kg/plant), NA-6 (12.0 kg/plant) and NA -10 (12.0 kg/plant) recorded lowest. The higher tree yield in cvs. Krishna and Chakaiya was due to higher fruit weight

and higher number of fruits per tree. The fruit yield was lowest (11.53 kg) in cv. BSR-1 despite of higher number of fruits (Table 2). This was due to low average fruit weight of this variety. The results are contrary to Bhavani Sanker *et al.* (1999) who had reported higher yield in cv. BSR-1 in different agro-climatic regions of Tamil Nadu. As far as fruit weight is concerned, it was found to be maximum in cv. Krishna (40.58 g) which was statistically at par with cv. NA-6 (37.72 g), whereas, the minimum fruit weight was recorded in cv. BSR-1 (18.59g). The same trend was also found in case of fruit volume and fruit size, fruit volume and pulp weight. The higher fruit weight, size and volume in case of cv. Krishna may be due to more activeness of mesocarp cells which enlarge during fruit development (Balasubramanyan and Bangarusamy, 1998). The pulp percent was maximum (95.5%) in cv. NA-6 but it was statistically similar to cvs. Krishna (95.33%), NA-7(94.16%) and Chakaiya (94.11%) (Table 3). This may be due of smaller sized stones inside the fruits. However, the minimum pulp percent was found in BSR-1 (91.34%). This result is in conformity with the result of Singh *et al.* (2009) and Sudhir Kumar *et al.* (2011) and Ghosh *et al.* (2013), who have reported the higher pulp content in cv. Krishna and lower pulp content in cv. BSR-1.

The total soluble solids were recorded at maximum in cv. BSR-1(11.50° Brix) and minimum in cv. Krishna (7.93° Brix). This is in conformity with the findings of Sudhir Kumar *et al.* (2011). The acidity was highest 3.53 percent in cv. BSR-1 and lowest in cv. Chakaiya (2.12 percent). The acidity percent was higher in all the varieties as compared to the acidity reported in previously reports in other locations. The higher acidity may be due to the low temperature, lesser sunshine period and high

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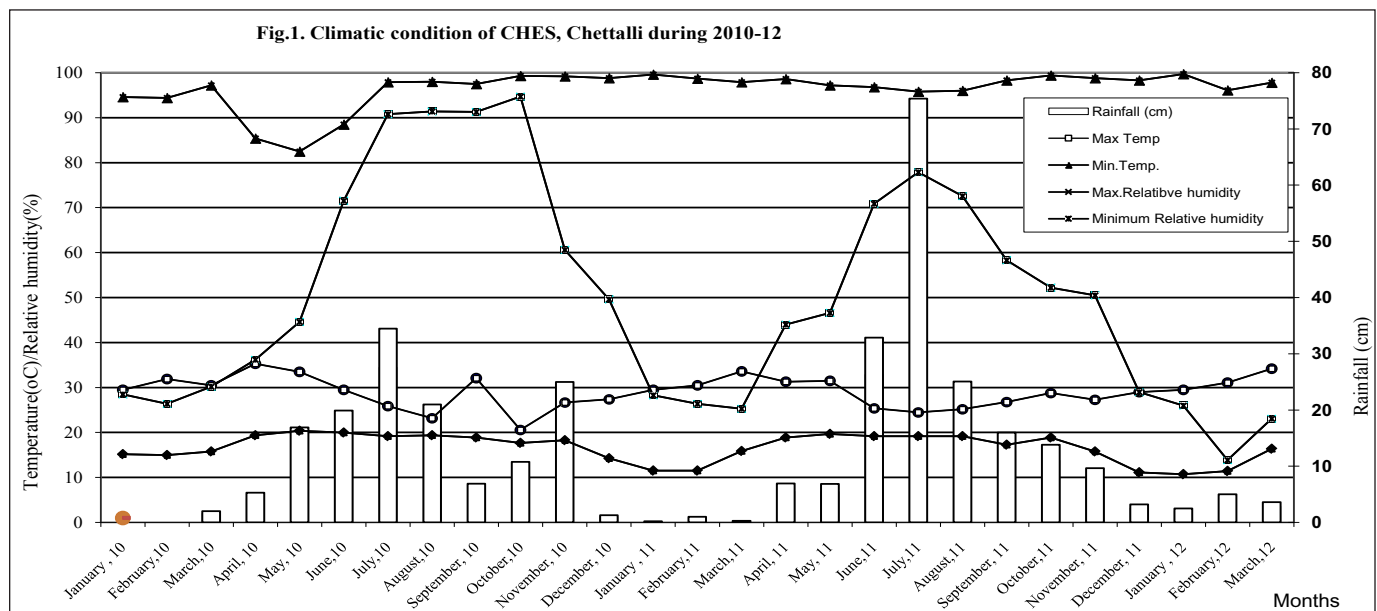


Table 1: Growth characteristics of aonla cultivars

Cultivar	Plant Ht. (m)			Rootstock girth (cm)			Scion girth (cm)			Plant spread(E-W)(m)			Plant spread(N-S)(m)							
	2010	2011	2012	Av	2010	2011	2012	Av	2010	2011	2012	Av	2010	2011	2012	Av				
Kanchan	5.14	5.26	5.30	5.23	53.38	57.38	57.75	56.17	55.10	55.63	56.24	55.66	3.83	3.83	3.90	3.85	3.84	3.88	4.11	3.94
NA-6	4.44	4.50	4.65	4.53	38.99	39.90	41.56	40.15	37.30	39.00	39.61	38.64	2.70	2.72	2.74	2.72	2.85	2.85	2.87	2.86
NA-7	4.14	4.21	4.28	4.21	42.50	43.02	43.69	43.07	41.40	42.50	43.54	42.48	3.31	3.34	3.36	3.34	3.24	3.33	3.33	3.30
NA-10	4.29	4.34	4.38	4.34	45.64	48.09	48.36	47.36	46.40	47.13	47.35	46.96	3.44	3.52	3.54	3.50	3.16	3.18	3.22	3.19
Krishna	4.41	4.49	4.60	4.50	40.69	41.24	57.75	46.56	40.70	41.28	42.38	41.45	3.27	3.57	3.89	3.58	3.28	3.28	4.00	3.52
Chakaiya	3.61	3.73	3.80	3.71	34.34	36.09	38.85	36.43	35.50	36.61	38.34	36.82	2.48	2.54	2.73	2.58	2.48	2.67	2.81	2.65
BSR-1	6.31	6.31	6.33	6.32	73.38	75.46	76.45	75.10	71.30	72.63	74.24	72.72	6.12	6.18	6.24	6.18	6.20	6.35	6.51	6.35
CD at 5%	1.17	1.23	1.24	1.19	4.56	4.53	4.68	4.63	4.15	4.23	4.18	4.24	2.01	2.05	2.04	2.07	1.97	1.94	1.98	1.96

Table2: Yield and physico-chemical properties of aonla cultivars

Cultivar	No of fruits/ plant			Yield (kg/plant)			Fruit wt (g)			Fruit volume (ml)						
	2010	2011	2012	Av	2010	2011	2012	Av	2010	2011	2012	Av				
Kanchan	371	799	624	598	15.31	24.51	20.17	20.00	41.28	30.68	32.32	34.76	39.70	29.48	31.06	33.41
NA-6	290	327	344	320	12.50	11.51	11.99	12.00	43.12	35.20	34.85	37.72	41.30	33.66	33.32	36.09
NA-7	508	353	390	417	18.30	9.50	10.00	12.60	36.03	26.92	25.63	29.53	35.10	26.19	24.93	28.74
NA-10	555	324	257	379	19.21	8.79	8.00	12.00	34.61	27.13	31.13	30.96	31.90	24.86	28.53	28.43
Krishna	646	657	645	649	29.32	24.91	24.80	26.34	45.38	37.91	38.45	40.58	43.20	35.98	36.49	38.56
Chakaiya	556	1122	716	798	21.20	34.79	24.34	26.78	38.13	31.01	34.00	34.38	36.50	29.78	32.65	32.98
BSR-1	579	705	593	625	12.30	11.55	10.75	11.53	21.25	16.38	18.13	18.59	20.20	15.42	17.07	17.56
CD at 5%	9.52	11.31	8.95	10.79	2.73	2.28	2.93	2.63	3.11	2.79	3.18	2.99	3.07	2.75	3.13	2.95

Table3: Physico-chemical properties of aonla cultivars

Cultivar	Fruit length (cm)			Fruit Diameter (cm)			Pulp wt (%)			Stone wt (%)						
	2010	2011	2012	Av	2010	2011	2012	Av	2010	2011	2012	Av				
Kanchan	4.57	3.40	3.58	3.85	5.23	3.89	4.10	4.41	94.69	94.69	91.27	93.63	5.31	5.31	8.73	6.37
NA-6	4.11	3.35	3.32	3.59	4.90	4.00	3.96	4.29	95.50	95.51	95.49	95.50	4.50	4.49	4.51	4.50
NA-7	4.36	3.26	3.10	3.57	4.90	3.66	3.49	4.02	94.17	94.17	94.15	94.16	5.83	5.83	5.85	5.84
NA-10	3.95	3.10	3.55	3.53	4.50	3.52	4.04	4.02	94.89	94.88	88.02	92.58	5.11	5.12	11.98	7.42
Krishna	4.41	3.69	3.74	3.95	5.01	4.19	4.25	4.48	95.33	95.33	95.34	95.33	4.67	4.67	4.66	4.67
Chakaiya	4.24	3.44	3.78	3.82	4.76	3.87	4.24	4.29	95.54	95.55	91.21	94.11	4.46	4.45	8.79	5.89
BSR-1	3.00	2.31	2.56	2.62	3.40	2.62	2.90	2.97	93.79	90.96	88.80	91.34	6.21	9.04	11.20	8.66
CD at 5%	0.41	0.38	0.43	0.42	0.45	0.43	0.46	0.44	1.45	1.39	1.37	1.38	0.35	0.31	0.33	0.34

Table 4: Physico-chemical properties of different aonla cultivars

Cultivar	TSS (°Brix)				Acidity (%)				Ascorbic acid (mg/100g pulp)				Reducing sugar (%)				Total sugar (%)			
	2010	2011	2012	Av	2010	2011	2012	Av	2010	2011	2012	Av	2010	2011	2012	Av	2010	2011	2012	Av
Kanchan	10.0	9.4	10.2	9.87	2.47	3.15	3.30	2.97	245.0	311.0	228.8	261.6	2.55	2.75	2.70	2.67	5.54	6.20	5.50	5.75
NA-6	9.0	8.5	8.5	8.67	2.41	2.84	2.82	2.69	285.5	312.0	329.5	309.0	1.92	2.11	1.82	1.95	6.01	6.85	6.35	6.40
NA-7	8.2	7.6	8.5	8.10	2.67	2.74	3.30	2.90	270.2	295	289.3	284.8	1.82	2.01	1.97	1.93	5.45	6.22	5.99	5.89
NA-10	8.2	7.8	8.5	8.17	1.61	2.11	3.04	2.25	306.0	310.4	309.7	308.7	2.11	2.82	2.77	2.57	6.85	7.54	7.36	7.25
Krishna	8.0	7.6	8.2	7.93	1.32	2.34	3.27	2.31	255.5	275.2	236.7	255.8	2.53	2.95	2.73	2.74	7.01	7.96	7.94	7.64
Chakaiya	8.2	9.4	9.8	9.13	1.61	2.10	2.64	2.12	332.5	352.0	319.4	334.6	2.77	2.96	2.93	2.89	7.85	8.98	8.54	8.46
BSR-1	10.5	11.5	12.5	11.50	2.95	3.16	4.47	3.53	415.3	457.2	448.8	440.4	3.45	3.62	3.52	3.53	8.22	9.20	8.82	8.75
CD at 5%	1.31	1.21	1.31	1.25	0.19	0.21	0.23	0.22	11.3	9.3	8.6	10.3	0.35	0.31	0.34	0.31	0.41	0.45	0.43	0.44

humidity of the region during the maturity of the fruits. The total sugars, reducing sugars, ascorbic acid and acidity were also found to be more in cv. BSR-1 (Table 4). This might be due to the inherent characters and low moisture content in the pulp at the time of harvesting. Similar findings were also reported by Balamohan *et al.* (2002) under sodic soils. From the findings, it can be concluded that aonla could be grown in high rainfall areas of Kodagu. The growth of the popular cultivars of North India is less in the regions but their yield was higher. Cv. BSR-1 was found better as far as the TSS, acidity, ascorbic acid content of the fruit is concern. But the yield level of this variety was low due to smaller size fruits. The yield level of cvs. Chakaiya and Krishna was highest among seven varieties studied. These two varieties along with cultivar BSR-1 are also suitable for cultivation in this region in terms of yield and quality parameters.

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