



## Evaluation of *aonla* germplasm for growth, yield and quality attributes in hot arid ecosystem

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### ABSTRACT

The performance of different commercial varieties of *aonla* was assessed under hot arid condition viz., Krishna, Kanchan Chakaiya, NA-6 NA-7, NA-10 and Anand-1. Observations with respect to growth parameters were taken during the month of June where as fruit characters were recorded at the time of harvesting in December. The plant height was maximum in NA-7 (3.46m) and minimum in Anand-1 (2.1m). Canopy spread of the tree in East-West and North-South directions varied from 2.75-4.0m and 4.20-3.0m respectively. The maximum plant girth was recorded in NA-6 (125 cm). Length of determinate shoot varied from 7.6 cm to 16.6cm and the range of leaf size was from 1.3-1.8 cm in different varieties. Maximum fruit size was observed in Krishna (3.92x4.60cm) and minimum in Kanchan (3.31x3.80cm). However, fruit weight varied from 30.16 to 48.3g depending on cultivar and it was maximum in Krishna (48.3g) and minimum in Kanchan (30.16g). total pulp weight was maximum in Krishna (45.6g) and minimum in Kanchan (28.77g) the size of stone was maximum in Krishna (2.45x1.48 cm). There were significant variation with respect to stone weight and different cultivars of *aonla*, which varied from 1.39 to 2.34g. Besides, there were significant variation with regards to yield, vitamin-c, juice content, TSS, dry matter and acidity in different cultivars. However, overall performance of the different cultivars that NA-7, Chakaiya, NA-6 and Krishna are promising for cultivation in hot arid ecosystem.

**Key words-** *Aonla*, cultivars, growth, yield, quality.

### INTRODUCTION

*Aonla* is also known as Indian gooseberry and a member of family Euphorbiaceae is originated in Tropical South East Asia particularly South India Ferminger (3), Morton (4). In India, it is widely grown Uttar Pradesh, Gujarat, Rajasthan, Madhya Pradesh and Tamil Nadu etc. It bears two types of shoot, on the basis of growth characteristics, these have been categorized as long or indeterminate and short or determinate Bajpai (1). The new determinate shoots emerged out during first week of April Bajpai (1), Ram (8) and where flowering takes place in axil of leaves. However, there are two prominent cropping season in South India i.e. July – August and April – May Naik (6). The fertilized ovary of *aonla* remains dormant for 3.5 month and resume growth in the month August after onset of monsoon. The fruits mature during the month of November – December under hot arid ecosystem of Rajasthan Shukla *et al.* (11). *Aonla* has gained momentum under hot arid region of the country because of its hardy nature, prolific bearing, potential fruit crop and capacity to grow under various adversities Shukla *et al.* (10). *Aonla* is rich source of

vitamin-C, pectin and main ingredient of chavanprash and Triphala. It is known as Amritphala due to its nutritive and energy restoring quality. It has vast scope of growing in wastelands like salt affected marginal arid and semi arid edaphological situations. It is moderately tolerant to salt even up to 30-40 ESP and 9-12 dsm<sup>-1</sup> Ec. After development of new cultivars viz Krishna, Kanchan NA-6, NA-7, NA-10 etc from Faizabad and Anand-1 and Anand-2 from Gujarat, the crop emerged as remunerative fruit crop in India Dhandar and Shukla (2). Since all the cultivars of *aonla* were not performing equally well under the hot arid ecosystem with respect to yield and quality attributes but due to extremes of high temperature and high wind velocity at the time of fruit setting. Keeping in view the present investigation was carried out to assess the performance of different varieties and to select the suitable varieties for commercial cultivation under hot arid ecosystem.

### MATERIALS AND METHODS

A study was undertaken during 2002 and 2003 to evaluate the performance of commercial varieties under hot arid ecosystem. The varieties viz. Krishna, Kanchan, Chakaiya, NA-6, NA-7, NA-10 and Anand-1 periodically

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observed. Planting was done at the distance of 8x8 m during 1996 and uniform cultural practices were provided for all cultivates. Observation with respect to growth parameter were taken during June where as observation on fruit characters were recorded at the time of harvesting. Height was measured with the help of ranging rod in metre. Data presented in table are mean value of two years. The data were analysed in RBD design with three replications using M-stat package. The mature fruits were taken randomly from all direction of plants from each variety and observation were recorded with respect to fruit characteristics. Size of fruit and stone was recorded with the help of vernier calliper. TSS were determined with the help of hand refractometer. Titrable acidity was estimated against N/10 NaOH and vitamin-C was estimated through standard dye solution Rangana (9).

## RESULTS AND DISCUSSION

Data pertaining to plant height (table 1) revealed that it was maximum in NA-7 (3.45m) followed by NA-6 (3.21m), NA-10 (3.11m) and Krishna (3.10m) where as minimum was recorded in Anand-1 (2.1m). Canopy spread in East West direction vary from 2.75 m to 4.0m. The maximum spread in East West direction was noted in NA-7 (4.0m) followed by 3.25m in NA-6, 3.20m in NA-10 and minimum was observed in Anand-1(2.75m). Canopy spread in North South direction was also maximum in NA-7 (4.20m) followed by Kanchan (3.5m) NA-6 (4.00m), NA-10 (3.20m), Anand-1(3.10m) where as minimum was found in Krishna (3.0m). Plant girth above the surface was recorded in inches in different cultivar of aonla. The maximum girth was recorded in NA-6 (125 cm) which was closely followed by Krishna and NA-7 (112.5 cm) where as minimum was noted in Chakaiya (80 cm).

Length of determinate shoot was varied from 7.6cm to 16.6cm in different varieties (Table 1). The maximum length was observed in NA-6 (16.6 cm) followed by NA-7 (15.9 cm), NA-10 (12.3 cm) and Anand-1 (10.5 cm) and minimum was recorded in Kanchan (7.6 cm). Leaf size was varied from 1.3-1.8 cm depending on cultivars with maximum in NA-6 (1.8 cm), followed by NA-7(1.7 cm), Chakaiya (1.6cm) and minimum under NA-10 and Kanchan (1.3 cm). Internodal length of determinate shoot varied from 0.31 to 0.81 cm. The maximum internodal length was observed in NA-6 (0.81cm) followed by NA-7 (0.46 cm), NA-10 (0.42cm) and minimum in Krishna (0.31 cm). Variation of plant growth characters in different cultivars is genetic feature of individual variety.

Fruit size is an important component of yield. The maximum fruit length was reported in Krishna (3.92 cm) followed by NA-6 (3.83 cm) and Chakaiya (3.65cm) where as minimum was found in Kanchan (3.51 cm). The maximum fruit diameter was observed in Krishna (4.6cm) which was closely followed by NA-6 (4.4 cm), Chakaiya (4.1 cm), and NA-7 (4.0 cm) where as minimum was reported in NA-10 and Anand-1 (3.8 cm). Fruit weight is major component of yield contributing factors. Fruit weight was varied from 30.16 to 48.3g depending on cultivars. The maximum fruit weight was reported in cultivar Krishna (48.3 g) which was closely followed by NA-6 (40.8 g), NA-7 (36.52 g), Chakaiya (33.4 g) where as it was minimum in Kanchan (30.16g). Total pulp weight was found maximum in variety Krishna (45.96 g) followed by NA-6 (39.09 g), NA-7 (34.93 g) and minimum was observed in Kanchan (28.77 g). Percent pulp content was varied from 94.15 to 95.89% depending on varieties.

Size of stone with respect to length was found maximum in Krishna (2.45 cm) followed by NA-7 (2.01

**Table 1.** Mean vegetative growth parameters of different aonla cultivars.

Cultivars	Length of determinate shoot(cm)	Leaf size (cm)	Internodal length of determinate shoots (cm)	Plant height (m)	Plant spread (m)		Plant diameter (inch)
					NS	EW	
Chakaiya	9.10 (6-13)	1.6	0.35	2.50	3.00	3.00	80.0
Krishna	8.4(5-12)	1.5	0.31	3.10	2.80	3.00	112.5
Kanchan	7.6(5-11)	1.3	0.38	2.91	3.00	3.50	90.0
NA-6	16.6(7-30)	1.8	0.81	3.21	3.25	4.00	125.0
NA-7	15.9(6-28)	1.7	0.46	3.45	4.00	4.20	112.5
NA-10	12.3(4-16)	1.3	0.42	3.11	3.20	3.20	105.0
Anand-1	10.5(4-13)	1.4	0.38	2.10	2.75	3.10	82.5
CD at 5%	2.37	0.43	0.08	0.27	1.27	0.32	13.76

Note: Data given in parenthesis is range value.

**Table 2.** Yield and yield attributes of different aonla cultivars.

Cultivars	Fruit size (cm)		Fruit weight (g)	Pulp weight (g)	Pulp content (%)	Stone weight (g)	Stone size		Seed weight (g)	Pulp/stone ratio	Stone content (%)	Yield kg/tree
	L	D					L	D				
Chakaiya	3.65	4.10	33.4	32.00	95.89	1.40	1.96	1.72	0.034	22.88	4.11	52
Krishna	3.7	4.60	48.3	45.96	95.15	2.34	2.45	1.92	0.036	19.65	4.85	45
Kanchan	3.6	3.95	31.25	29.69	95.01	1.56	1.82	1.68	0.031	19.03	4.99	35
NA-6	3.6	4.40	40.8	39.09	95.8	1.71	1.80	1.62	0.034	22.86	4.20	67
NA-7	3.5	4.00	36.52	34.93	95.64	1.59	2.01	2.15	0.028	21.98	4.36	105
NA-10	3.5	3.8	30.16	28.77	95.39	1.39	1.48	1.39	0.029	20.73	4.61	31
Anand-1	3.5	3.8	31.35	29.83	95.15	1.52	1.52	1.42	0.031	19.61	4.85	25
CD at 5%	0.97	1.06	4.35	5.29	0.58	0.48	0.57	0.51	0.014	3.25	1.81	12.12

**Table 3.** Quality attributes of different aonla cultivars.

Cultivars	Juice content (%)	Dry matter (%)	TSS (%)	Acidity (%)	Vitamin-C (mg/100 g)	TSS/acid ratio
Chakaiya	73.65	16.4	18.00	2.04	594	8.82
Krishna	75.30	18.39	17.50	2.35	542	7.65
Kanchan	69.36	14.75	14.90	2.70	632	5.51
NA-6	74.39	17.58	19.30	2.43	559	7.94
NA-7	75.38	16.8	15.20	2.51	612	6.05
NA-10	66.35	14.02	15.40	2.02	678	7.62
Anand-1	71.69	14.93	16.60	2.14	556	7.75
CD at 5%	7.47	4.38	4.45	0.57	26.92	2.18

cm), Chakaiya (1.96 cm) and minimum was recorded in NA-10 (1.48 cm). Stone diameter was found maximum in NA-7 (2.15 cm), and minimum was noted in NA-10 (1.39 cm). There was sufficient variation with respect to stone weight in different cultivars of aonla which varied from 1.39 to 2.34 g with the maximum recorded in Krishna (2.34 g) and minimum was found in NA-10 (1.39 g). The seed weight in aonla was found maximum in Krishna (0.036 g) where as minimum was recorded in NA-7 (0.028g). Pulp stone ratio was recorded maximum in Chakaiya (22.88) and minimum in Kanchan (19.03). The stone content (%) was varied between 4.11-4.99% with maximum in Kanchan (4.99%) and minimum was found in Chakaiya (4.11 %). The fruit yield per tree was recorded maximum in NA-7 (105 kg) this may be due to more number of fruit per shoot. Pathak and Pathak (7) also attributed high fruit yields in these cultivars due to production of larger proportion of female flowers. Juice content in different varieties of aonla is varied from 66.35 to 75.38% with the maximum 75.38% in NA-7 and minimum in NA-10 (66.35%). Dry matter content was reported highest in Krishna (81.39%) and lowest was noted in Kanchan (14.02%). TSS was found maximum in NA-6 (19.30%) and minimum in Kanchan (14.90%).

Aonla growing in arid region with limited water tended to more accumulation of dry matter and lower moisture may result in higher TSS in fruits Meghwal and Azam (5). Acidity in fruit was recorded highest in Kanchan (2.70%) and minimum was observed in Chakaiya 2.04%). However, vitamin-c was found maximum in NA-10 (678mg) and minimum in Krishna (542mg) where as TSS/acid ratio was found maximum in Chakaiya (8.82) and minimum in Kanchan (5.51). The variation in physico-chemical attributes including vitamin-C of different cultivars have been also reported by Teotia *et al.* (12).

## REFERENCES

1. Bajpai, P.N. 1965. Studies on vegetative growth and development of male and female gametophyte in aonla (*Emblica officinalis* Gaertn) *Agra Univ. J. Res. Sci.* **14**: 167-86.
2. Dhandar D.G. and Shukla A.K. 2003. Varietal Improvement in aonla. Paper presented in National Seminar on production and utilization of aonla, 8-10 Augus, 2003 at Salem, Tamil Nadu.
3. Ferminger T.A. 1947. Ferminger manual of gardening in India 8<sup>th</sup> Edn. Thaker Spink & Co. Ltd, Calcutta.

4. Morton, J.F. 1960. The emblic. *Eco. Bot.* **14**: 119-27.
5. Meghwal P.R. and Azam, M.M. 2004. Performance of some aonla cultivars in arid region of Rajasthan. *Indian J. Hort.* **61**: 87-88.
6. Naik, K.C. 1963. South Indian Fruits and their culture. P. varadachary and Co. Madras.
7. Pathak, R.K. and Pathak R.A. 1983. Improvement of Minor fruits In: *Advances in Horticulture*. Chadha, K.L. and Pareek, O.P. (Eds.). Malhotra Publishing house, New Delhi.
8. Ram, S. 1971. Studies on physiology of fruit growth in Aonla (*Emblica officinalis* G) Ph.D thesis submitted to Kanpur University, Kanpur.
9. Rangana S. 1986. hand book of analysis of fruit and vegetable products. Tata Mc Graw-Hill Publishing Company Limited, New Delhi
10. Shukla, Arun Kumar, Shukla, Anil Kumar, Awasthi, O.P. and Vashishtha B.B. 2002. Shushak Kshetra Mein Aonla Utpadan, *Krishi Chayanika*, **23**: 20-22
11. Shukla Arun Kumar, Shukla, Anil Kumar, Saroj, P.L. and Dhandar, D.G. 2004a. Studies on floral biology of aonla under arid conditions. *Ann. Agri. Res.*, (Accepted).
12. Teatota S.S. Singh D.B. Singh R.D. and Singh R.N. 1968. Studies on some important varieties of aonla (*Phyllanthus emblica* L.) of eastern U.P. *Punjab Hort. J.* **8**: 241-44.

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