

Exploration and Selection of Elite Wild Aonla (*Phyllanthus emblica* L.) Genotypes in the Mountainous Tracts of West Garo Hills, Meghalaya

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ABSTRACT

An experiment was conducted at Department of Horticulture, North-Eastern Hill University, Tura Campus to study the characterization local aonla genotypes using various physiochemical parameter for evaluating diversity and identifying potentially useful genotypes for future breeding programs and quality enhancement. In all the 40 genotypes collected, the maximum fruit length was observed in the genotype WGHA 21 (23.62mm) and maximum fruit diameter was observed in the genotype WGHA 16 (25.94mm). The heaviest fruit weight was recorded in the geno-

types WGHA 16 (9.66g) while the fruit volume was reported highest in genotype WGHA 40 (3.40ml) and minimum was reported in genotype WGHA 2 (0.59ml). As per the recorded data pulp weight was recorded the maximum in the genotype WGHA 16 (8.34g). The genotype WGHA 33 (9.78mm) was found to have the thickest pulp. Significantly maximum pulp percent was observed in the genotype WGHA 39 (93.87%) and minimum was observed in the genotype WGHA 30 (69.65%). In case of stone weight, the heaviest was observed in the genotype WGHA 40 (1.47g). The qualitative character TSS reported in the genotypes WGHA 18 (20.27 °Brix) was found to be the highest. The acidity recorded the lowest was in the genotype WGHA 29 (0.51%) and the highest was observed in the genotype WGHA 39 (3.67%). Ascorbic acid content reported in the genotype WGHA 39 (841.48mg/100g) was the highest among all other genotypes while significantly highest amount of total sugar was observed in the genotype WGHA 9 (1.29%). Moreover, reducing sugar reported in genotype WGHA 4 (1.20%) was the highest and the lowest observed was in the genotype WGHA 28 (0.46%). In case of non-reducing sugar highest was observed in the genotype WGHA 9 (0.54%). Based on the study conducted the genotypes WGHA 4, 8, 9, 16, 18, 21,23, 26, 28, 31, 32, 33,35,38, 39 and 40 gave promising results in terms of physical and bio-chemical attributes and can be studied for further evaluation.

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INTRODUCTION

There are many improved aonla cultivars that have been developed in the country, but they still do not perform well in a specific region due to the lack of acceptability. There is a wide range of aonla genetic diversity in north-eastern India, particularly in lowland Assam, Meghalaya, and Tripura. The Himalayas, as well as the forests of Khasi and Garo Hills in Meghalaya, sheltered a considerable amount of wild elite germplasm. It provides greater opportunities for creating desirable clones through simple seedling selection. Plus trees, or elite trees selected for total yield, size and quality of fruit, are the beginning point of every tree improvement program. Selection of a large number of elite trees provides an instantaneous seed source with relatively significant genetic gain. They also provide scion material for vegetative propagation, which can immediately be used as better planting material. In nature, there are plentiful variations in fruit form and size, fruit and pulp color, TSS, acidity and earliness in bearing of this fruit. These variants can be used to develop a selection of superior seedlings. To advance the economy of aonla orchards, there is an urgent need to select or develop varieties from a diverse natural population for superior characteristics such as high TSS, a good balance of TSS and acidity, hard flesh, good flavor and aroma, as well as resistance or tolerance to insect pests such as fruit fly and diseases such as powdery mildew and sooty mould. A great variety of aonla cultivars have been created thus far, but none of them contain all the desired characteristics. As a result, investigations are required to characterise local aonla genotypes using physiochemical features to assess diversity and find potentially prospective genotypes for quality improvement and future breeding programmes.

The West Garo Hills district is bordered by the East Garo Hills district to the east, the South Garo Hills district to the south-east, the Goalpara district of Assam to the north and north-west, and Bangladesh to the south. It is located between latitudes 90°30' and 89°40' E, and longitudes 26° and 25°20' N. The district covers an area of 3714 square kilometres. This region is in the subtropical and tropical agro-forestry climate zone. The district's climate is mostly influenced by the southwest monsoon and seasonal

winds. The West Garo Hills district, which is lower in altitude than the rest of Meghalaya experiences quite high temperatures for most of the year. The average rainfall is 330 centimeters, with more than two-thirds falling during the monsoon season, while winter is almost completely dry. The district is largely covered in dense tropical mixed forest, with a small patch of temperate woodland at the upper elevations of the Tura Range.

MATERIALS AND METHODS

In 2020-2021, the experiment was undertaken at Department of Horticulture, North-Eastern Hill University, Tura Campus, Meghalaya. The study was conducted in a randomised block design with three replicates. This analysis identified 40 potential genotypes from different locations namely R.C. Road, Chitoktak, Asanang, Oragitok, Sunny Hills, Walbakgre, Matchurigre, Alotgre, Chasingre, Ganol Songma, Ronggindi, Cherangre, Babadam, Chibagre, Agillangre, Danak Adingre, Daluagre, Waribok, Aguragre and Wachi gittim (Table 1). The fruits from various sites were measured for physical and biochemical characteristics. The bio-chemical properties of the fruits were estimated using standard procedures (AOAC 1990).

Table 1. GPS coordinates of different locations of aonla trees.

Genotype	GPS coordinates		
	Latitude	Longitude	Elevation
WGHA1	N25°30.880'	E090°12.535'	371m
WGHA2	N25°32.379'	E090°13.843'	390m
WGHA3	N25°31.615'	E090°13.572'	443m
WGHA4	N25°34.947'	E090°14.256'	426m
WGHA5	N25°36'4.82076'	E90°16'32.34'	447m
WGHA6	N25°35'32.32032'	E90°16'56.52912'	441m
WGHA7	N25°33'20.93904'	E90°18'57.52332'	681m
WGHA8	N25°33'18.74304'	E90°19'3.67248'	693m
WGHA9	N25°32.379'	E090°13.843'	217m
WGHA10	N25°30'16.00884'	E90°11'36.46716'	200m
WGHA11	N25°30'59.77944'	E90°10'13.88172'	214m
WGHA12	N25°31'17.60592'	E90°10'23.22408'	255m
WGHA13	N25°33'13.24692'	E90°18'30.4218'	7m
WGHA14	N25°33'15.31476'	E90°18'303192'	3m
WGHA15	N25°32.080'	E90°12.509'	441m
WGHA16	N25°32.076'	E090°12.516'	414m
WGHA17	N25°34'16.28256'	E90°13'45.73776'	444m
WGHA18	N25°34'8.11236'	E90°13'40.68948'	439m
WGHA19	N25°34.469'	E090°14.559'	411m
WGHA20	N25°34.472'	E090°14.552'	343m

Table 1. Continued.

Genotype	GPS coordinates		
	Latitude	Longitude	Elevation
WGHA21	N25°33.419'	E090°13.352'	382m
WGHA22	N25°33.365'	E090°13.179'	365m
WGHA23	N25°33.411'	E090°13.336'	391m
WGHA24	N25°35.274'	E090°11.633'	438m
WGHA25	N25°35.601'	E090°08.255'	374m
WGHA26	N25°35.547'	E090°08.296'	378m
WGHA27	N25°34.947'	E090°14.253'	416m
WGHA28	N25°35.547'	E090°08.296'	391m
WGHA29	N25°31'2.27784'	E90°11'36.65112'	248m
WGHA30	N25°31.191'	E090°11.992'	226m
WGHA31	N25°35.053'	E090°13.034'	149m
WGHA32	N25°35.834'	E090°11.514'	149m
WGHA33	N25°24.933'	E090°13.387'	159m
WGHA34	N25°24.928'	E090°13.439'	154m
WGHA35	N25°36.710'	E090°20.058'	663m
WGHA36	N25°36.429'	E090°20.012'	702m
WGHA37	N25°36.281'	E090°17.825'	693m
WGHA38	N25°36.293'	E090°17.817'	731m
WGHA39	N25°36.245'	E090°17.876'	658m
WGHA40	N25°41'23.92404'	E90°20'49.33752'	646m

WGHA=West Garo Hills Aonla.

RESULTS AND DISCUSSION

Physical characters

The maximum fruit length was observed in the genotype WGHA 21 (23.62mm) and the lowest was observed in the genotype WGHA 3 (13.70mm) (Table 2). Significantly maximum fruit diameter was observed in the genotype WGHA 16 (25.94

Table 2. Physical parameters of fruits in various genotypes of aonla.

Genotypes	Fruit length (mm)	Fruit diameter (mm)	Fruit weight (g)	Fruit volume (ml)
WGHA1	14.99	19.08	3.52	1.55
WGHA2	14.29	18.76	2.74	0.59
WGHA3	13.70	14.82	2.14	1.43
WGHA4	19.14	20.88	5.82	1.62
WGHA5	16.72	19.52	3.94	0.74
WGHA6	18.46	20.74	5.04	1.05
WGHA7	19.81	20.62	5.10	1.10
WGHA8	15.48	16.72	2.90	2.44
WGHA9	20.13	22.92	6.63	1.10
WGHA10	17.43	22.27	5.24	1.74
WGHA11	15.95	19.66	3.88	1.29
WGHA12	18.31	18.36	3.77	1.57
WGHA13	15.95	18.63	3.40	2.06
WGHA14	18.34	22.02	5.81	1.35

Table 2. Continued.

Genotypes	Fruit length (mm)	Fruit diameter (mm)	Fruit weight (g)	Fruit volume (ml)
WGHA15	17.91	20.38	4.70	1.17
WGHA16	21.79	25.94	9.66	1.63
WGHA17	16.35	18.28	3.55	2.18
WGHA18	17.54	20.78	4.90	2.17
WGHA19	14.56	15.57	3.24	1.26
WGHA20	19.06	22.88	6.44	1.22
WGHA21	23.62	25.25	9.28	0.81
WGHA22	16.88	18.14	3.63	1.11
WGHA23	21.45	25.38	8.66	1.04
WGHA24	18.34	22.06	5.67	1.86
WGHA25	17.55	20.58	5.03	1.40
WGHA26	18.11	21.78	5.48	1.20
WGHA27	18.57	22.46	6.29	1.38
WGHA28	16.87	17.71	3.44	2.25
WGHA29	19.98	22.44	6.56	1.27
WGHA30	14.92	15.39	2.27	1.54
WGHA31	18.58	21.82	5.83	1.28
WGHA32	18.33	19.72	4.44	2.22
WGHA33	20.00	24.80	8.26	1.37
WGHA34	16.54	19.57	4.33	1.56
WGHA35	18.78	18.77	4.17	1.38
WGHA36	18.80	19.65	4.45	1.11
WGHA37	16.10	20.26	4.30	2.15
WGHA38	19.50	20.35	5.05	1.26
WGHA39	18.53	21.90	5.95	0.99
WGHA40	20.75	22.93	6.80	3.40
Mean	17.95	20.50	5.06	1.50
SEm±	0.40	0.50	0.19	0.28
CD (5%)	1.14	1.43	0.53	0.80
CV (%)	3.13	4.29	6.45	12.89

Table 3. Physical parameters of fruits in various genotypes of aonla.

Genotypes	Pulp weight (g)	Pulp thickness (mm)	Pulp per cent (%)	Stone weight (g)
WGHA1	2.85	6.25	81.01	0.58
WGHA2	2.36	7.18	85.93	0.30
WGHA3	1.69	4.22	79.33	0.51
WGHA4	4.45	6.75	76.36	0.97
WGHA5	2.77	3.54	72.79	0.74
WGHA6	4.32	6.82	84.79	0.68
WGHA7	4.24	7.30	83.20	0.73
WGHA8	2.23	5.03	76.78	0.59
WGHA9	5.61	7.76	84.62	0.93
WGHA10	4.05	6.61	77.23	1.11
WGHA11	3.18	6.17	81.89	0.65
WGHA12	2.85	4.86	75.49	0.86
WGHA13	2.66	5.41	78.32	0.59
WGHA14	4.76	6.88	81.91	0.92
WGHA15	3.75	5.30	86.21	0.95
WGHA16	8.34	8.16	86.41	1.13
WGHA17	2.73	5.27	76.89	0.70

Table 3. Continued.

Genotypes	Pulp weight (g)	Pulp thickness (mm)	Pulp per cent (%)	Stone weight (g)
WGHA18	3.93	5.25	87.13	0.82
WGHA19	2.43	3.83	74.94	0.64
WGHA20	5.31	6.83	82.54	1.03
WGHA21	7.19	8.70	76.92	1.24
WGHA22	2.78	5.74	76.48	0.73
WGHA23	7.37	8.73	89.65	1.23
WGHA24	4.59	6.96	80.87	1.01
WGHA25	4.18	7.38	83.17	0.80
WGHA26	4.69	8.78	85.66	0.68
WGHA27	5.09	7.17	80.83	1.12
WGHA28	2.59	6.62	84.62	0.79
WGHA29	5.56	7.04	84.76	0.90
WGHA30	1.58	5.41	69.65	0.54
WGHA31	4.49	6.56	76.94	1.03
WGHA32	3.63	6.28	81.70	0.59
WGHA33	7.21	9.78	87.39	0.75
WGHA34	3.54	5.14	81.89	0.60
WGHA35	3.03	4.74	72.82	0.88
WGHA36	3.45	5.90	77.58	0.93
WGHA37	3.35	7.75	77.91	0.69
WGHA38	3.59	5.58	71.29	1.39
WGHA39	4.82	5.91	93.87	1.01
WGHA40	5.24	6.71	77.12	1.47
Mean	4.06	6.41	80.62	0.85
SEm±	0.21	0.53	2.71	0.08
CD (5%)	0.59	1.51	7.64	0.23

mm) and minimum was observed in the genotype WGHA 3 (14.82mm). Among all the 40 genotypes the heaviest fruit weight was recorded in the genotype WGHA 16 (9.66g) and lightest was recorded in the genotype WGHA 3 (2.14g). Maximum fruit volume was reported in the genotype WGHA 40 (3.40ml) and the minimum was reported in the genotype WGHA 2

(0.59ml). The maximum pulp weight was recorded in the genotype WGHA 16 (8.34g) and minimum was recorded in the genotypes WGHA 30 (1.58g). Genotype WGHA 33 (9.78mm) was found to have the thickest pulp and genotype WGHA 5 (3.54mm) was found to be thinnest out of all the 40 genotypes. Significantly maximum pulp percent was observed in the genotype WGHA 39 (93.87%) and minimum was observed in the genotype WGHA 30 (69.65%) (Table 3). The heaviest stone weight was observed in the genotype WGHA 40 (1.47g) and lightest was observed in the genotype WGHA 2 (0.30g).

Bio-chemical characters

Among the qualitative characters, TSS reported in the genotypes WGHA 18 (20.27 °Brix) was found to be the highest and genotype WGHA 2 (7.03 °Brix) was found to be the lowest (Table 4). The acidity recorded the lowest was in the genotype WGHA 29 (0.51%) and highest was observed in the genotype WGHA 39 (3.67%). Ascorbic acid content which was reported in the genotype WGHA 39 (841.48mg/100g) was highest and lowest was observed in the genotype WGHA 2 (61.66mg/100g). Significantly highest amount of total sugar was observed in the genotype WGHA 9 (1.29%) and lowest was observed in the genotype WGHA 28 (0.58%). Reducing sugar reported in genotype WGHA 4 (1.20%) was the highest and the lowest was observed in the genotype WGHA 28 (0.46%). In case of non-reducing sugar WGHA 9 (0.54%) was found to be the highest and lowest was observed in the genotype WGHA 32 (0.04%).

Table 4. Biochemical parameters of fruits in various genotypes of aonla.

Genotypes	Total soluble solids (°Brix)	Acidity (%)	Ascorbic acid (mg/100g)	Total sugar (%)	Reducing Sugar (%)	Non reducing sugar (%)	TSS : Acid ratio
WGHA1	13.17	1.07	203.04	0.92	0.73	0.19	12.34
WGHA2	7.03	0.85	61.66	0.93	0.82	0.11	8.24
WGHA3	11.17	1.28	423.75	0.77	0.69	0.08	8.72
WGHA4	10.47	1.49	405.70	1.27	1.20	0.07	7.01
WGHA5	15.03	1.79	498.58	0.79	0.71	0.08	8.39
WGHA6	13.43	1.49	458.34	0.74	0.63	0.12	9.00
WGHA7	10.73	1.88	585.81	0.79	0.71	0.08	5.72
WGHA8	13.87	1.62	566.26	0.89	0.60	0.29	8.55
WGHA9	9.93	1.71	642.21	1.29	0.75	0.54	5.82
WGHA10	14.47	1.54	568.51	0.80	0.70	0.10	9.42
WGHA11	11.97	2.26	444.81	0.78	0.55	0.22	5.29

Table 4. Continued.

Genotypes	Total soluble solids (°Brix)	Acidity (%)	Ascorbic acid (mg/100g)	Total sugar (%)	Reducing Sugar (%)	Non reducing sugar (%)	TSS : Acid ratio
WGHA12	14.00	1.96	449.70	0.68	0.57	0.11	7.13
WGHA13	16.47	2.13	638.45	0.69	0.63	0.06	7.72
WGHA14	10.17	0.85	573.78	0.76	0.70	0.07	11.91
WGHA15	13.80	2.47	670.78	0.91	0.78	0.13	5.58
WGHA16	16.37	2.09	630.93	0.59	0.54	0.05	7.83
WGHA17	16.10	1.75	440.30	0.73	0.60	0.14	9.20
WGHA18	20.27	2.18	415.86	0.59	0.55	0.04	9.31
WGHA19	14.97	1.58	524.90	0.75	0.66	0.09	9.48
WGHA20	11.30	1.92	547.46	0.66	0.54	0.11	5.89
WGHA21	13.33	1.79	691.09	0.80	0.58	0.22	7.44
WGHA22	13.77	2.01	697.10	0.82	0.71	0.11	6.87
WGHA23	13.73	2.30	453.46	0.68	0.54	0.23	5.96
WGHA24	11.17	2.13	410.59	0.83	0.79	0.04	5.23
WGHA25	15.73	2.05	630.93	0.60	0.48	0.12	7.68
WGHA26	12.33	1.71	698.61	0.62	0.55	0.07	7.23
WGHA27	12.53	2.01	418.87	0.73	0.50	0.23	6.25
WGHA28	16.43	3.20	388.78	0.58	0.46	0.12	5.14
WGHA29	14.27	0.51	435.41	0.76	0.67	0.09	27.86
WGHA30	11.20	1.83	506.85	0.91	0.77	0.14	6.10
WGHA31	17.40	1.88	556.86	0.68	0.63	0.05	9.27
WGHA32	19.23	3.24	652.74	0.66	0.62	0.04	5.93
WGHA33	13.63	2.82	749.74	0.58	0.50	0.08	4.84
WGHA34	12.77	3.03	789.98	0.65	0.56	0.10	4.21
WGHA35	13.33	2.18	644.09	0.89	0.59	0.30	6.13
WGHA36	15.10	1.96	587.69	0.71	0.62	0.09	7.69
WGHA37	13.00	1.83	624.54	0.94	0.79	0.25	7.09
WGHA38	12.27	2.05	558.36	0.74	0.64	0.13	5.99
WGHA39	11.07	3.67	841.49	0.94	0.84	0.10	3.02
WGHA40	8.73	2.94	803.51	0.79	0.61	0.18	2.97
Mean	13.39	1.98	547.29	0.78	0.65	0.13	305.46
SEm±	0.79	0.39	9.67	0.13	0.13	0.27	1.30
CD (5%)	2.23	1.09	27.27	0.36	0.38	NS	NS

DISCUSSION

The physico-chemical characteristics of the fruit decide the suitability and the stability of a variety of a crop and not the yield. Singh *et al.* (2022) have stressed the importance of these characters in Aonla fruit. Moreover, Chiranjeevi *et al.* (2018) conducted an experiment to evaluate the performance of six different varieties of Aonla for physico-chemical characteristics under Bengaluru condition. Their study revealed that, significant variability was observed among the varieties for different aonla fruit, seed and biochemical traits. From an experiment conducted by Pandey *et al.* (2016), they found that the biggest size of fruits was observed in NA-7, whereas, small size

fruits were observed in Krishna. Moreover, maximum weight of fruit was recorded in NA-7 (42.44 g). Findings with respect to these characters were also observed in the present study where the fruit weight ranged from 2.14 g (WGHA-3) to 9.66 g (WGHA-16) which is quite low as compare to the cultivated varieties and this may be due to the genetic make up of the collected genotype.

Taste is complex character, which is contributed to a greater extent by TSS, acidity, ascorbic acid and other biochemical constituents. A wide variation was observed with respect to these characters in the present study. Earlier workers also reported similar variation in these characters (Kumar *et al.* 2025 and

Anadani *et al.* (2021)) in bael, Ghosh *et al.* (2017) in jamun and Dey and Baruah (2019) in jackfruit. Pandey *et al.* (2016) conducted a study on some physico-chemical characters of aonla genotypes where they reported wide variability with respect to TSS of juice (10.00-21.30 °Brix), acidity (1.84-3.95%), total sugar (8.15-13.15 %) and vitamin C (375.00-1428.50 mg/100 ml of fruit juice) among the genotypes. The genotype T12 and T14 were found superior in terms of their physicochemical attributes than the rest of the genotypes collected in their investigation. In the present study a close similarity was observed in TSS, acidity, total sugar, and ascorbic acid content in fruit which ranged from 7.03% to 20.27%, 0.51% to 3.67%, 0.58% to 1.29% and 61.66 mg to 841.48 mg/100 ml of fruit juice respectively.

CONCLUSION

Based on the study conducted the genotypes WGHA 4, 8, 9, 16, 18, 21,23, 26, 28, 31, 32, 33,35,38, 39 and 40 are promising elite genotypes in terms of physical and bio-chemical attributes and can be studied for further evaluation.

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