Research Article

Identification and Conservation of Elite Water Apple (*Syzygium aqueum* Alst.) Genotypes from West Bengal

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Abstract

A study was conducted to identify the elite water apple germplasm among its natural population from different locations of Nadia district of West Bengal. Water apple trees in 20 different locations were initially screened for their fruit quality characters out of which 10 quality germplasm were selected for detailed studies including flowering, fruiting and fruit bio-chemical properties. The 10 different elite class germplasm were evaluated for characters like number of flowering flushes, peak flowering time, peak fruiting season, second fruiting season, overall abundance of flowering, flower colour, fruit length (in cm), fruit diameter (in cm), average weight of 10 fruits (in g), seeds per fruit, edible part percentage (%), fruit shape, fruit colour, TSS (^{O}B), titratable acidity (%), total Sugar (%), reducing sugar (%) and ascorbic acid (mg/100g). Keeping in view all the above results, it was found that the Acc. 4 (Ranaghat) and Acc. 9 (Chakdah) fruits are large in size, yellowish-white colour, high percentage of edible portion, ideal amount of total and reducing sugar, perfect acid-sugar blend and have high ascorbic acid content. Fruits with such desirable characters are expected to have tremendous market demand. Hence, the following germplasm can be conserved by asexual propagation and can be harnessed in future breeding programs.

Keywords: accessions, jamrul, water apple germplasm, characterization, water-apple

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Introduction

Water apple (*Syzygium aqueum* Alst.) also known as watery rose apple is one of the most nutritious fruit crops under the family Myrtaceae. Several local names are used for this fruit crop likely “Jamrul” in Bengali, “Chambakka” or “PaniSeb” in Hindi, “Jambu” or “Panneer Naval” in Tamil, “Jambakka” in Malayalam and “Gulaabijamichettu” or “Gulaabijamikaayalu” in Telugu. This succulent delicious fruit has thirst-quenching properties and usually consumed raw [1]. The origin of this fruit is southern India and Malaysia and generally cultivated in India, south-eastern Asia and Indonesia [2].

In West Bengal, it is still considered as an underutilized fruit crop and seen to be grown wild in yards or unmanaged lands in villages and most of the farmers are not yet into cultivation of this particular fruit crop commercially. All the parts of this plant have some specific properties like the dried leaves can cure cracked tongue, preparation from the roots can relieve itching and reduce swelling, the wood being hard can be used in small handicraft, the decoction of the astringent bark is used in thrush etc. The fleshy fruit has several medicinal uses that can cure several ailments like heart and liver disorders and it is well acclaimed by traditional medical practices in India namely Unani, Ayurveda and Siddha.

Water apple is cultivated in the lower elevation of tropical and sub-tropical regions with adequate rainfall well distributed throughout the year. The water apple fruit is ideal for weight loss due to its low-calorie content and negligible amount of saturated fat. It also provides dietary fibre that helps in proper digestion. The fruit is an abundant source of Vitamin A, B, C, iron, calcium and antioxidants. The fruit have tremendous capability to treat asthma, diabetes mellitus, bronchitis and inflammation syndromes [3]. The fruit is a rich source of minerals, antioxidants and have potential to scavenge free radicals, act as anti-mutant and have anti-cancerous property [4]. The pulp of water apple is known to be abundant in flavonoids and phenols and hence it has prodigious potential to cure diabetes. The fruit also have tremendous anti-oxidant potential [5, 6]

There is limited information on the germplasm of water apple for selection of superior characters. Germplasm collection is a basic and very important step of improvement in any crop [7]. Genetic variability is considered one of the most desired components for selection of the best performing parents for further use in breeding programme. By

natural selection and spontaneous mutation, some trees growing in roadside and homestead might have several desirable properties and marvelous fruit characteristics which the consumer wants in the market. In our study an attempt has been made to visit local villages and identify the Jamun trees with exceptional characters based on flowering, fruiting and bio-chemical properties of the fruit. Later the trees with superior traits can be multiplicated and conserved for future research.

Materials and Methods

Initial survey was done in Nadia district of West Bengal to identify and select 20 trees from distinct locations. The trees were of age between 10 - 20 years and were vegetative vigorous. These trees were geographically tagged and in the 1st year, fruits from 25 trees were collected. Out of the 20 different trees, 10 best accessions based on initial fruit quality were identified which were shortlisted for further studies about flowering, fruiting and detailed physio-chemical properties. The studies about flowering and fruiting properties were done in the location of the trees itself whereas the bio-chemical properties of the fruits were studied in Post Graduate Laboratory, Department of Post harvest technology, BCKV, Mohanpur. Final studies on 10 best accessions were done in Nabadwip, Krishnanagar, Haringhata, Ranaghat, Shantipur, Karimpur, Gede, Palashi, Chakdah and Kalyani which were named as Acc-1, Acc-2 to Acc. 10 respectively. The design of the experiment was Randomized Block Design (RBD) with 10 accessions as ten different treatments and 3 replications each.

Number of flowering and fruiting flushes, peak flowering time, peak fruiting season, second fruiting season, overall abundance of flowering and flower colour were determined based on researcher regular observation and opinion of local people. The fruit dimension was measured by vernier calipers. Fruit weight as average of 10 fruits by using electronic weighing balance. Pulp percentage was determined on the basis of total pulp weight with comparison to total fruit weight. Total soluble solid (TSS) was estimated by using the hand refractometer. Bio-chemical assessment of the fruits like the titratable acidity (TA), ascorbic acid content, reducing sugar and total sugar (TS) was done by method suggested by Association of Analytical chemists [8].

Results and Discussions

Flowering characters

Table 1 highlights the flowering characteristics of different water apple accessions collected from Nadia district of West Bengal. Out of the 10-accession studied, each and every accession have habit of flowering twice a year. Flowering was in two flushes in all the accessions studied. The peak season of flowering was early-March to mid-March in all accessions except ACC-10 where flowering was during later half of March. The time for second flowering was late April to early May in all the accession except ACC-10 where flowering was at earlier half of November month. The peak fruiting season was late May and early June in all accessions except ACC-10 which have major fruiting season at middle and later half of June. The second fruiting was during later monsoon (July - August) in all accessions except ACC-10 which shows fruiting in the earlier weeks of February. Quite exceptionally the ACC-10 has very late fruiting both in main fruiting season and off season as well. Overall abundance of flowering was profuse in ACC- 1, ACC-2, ACC-4, ACC-5, ACC-7, ACC-9 and ACC-10 and moderate in ACC-3, ACC-6 and ACC-8. The flower colour was pale-yellow in all the accessions except more whitish and less yellow in ACC-2 and ACC-10.

Table 1 Flowering characteristics of different water apple accessions

Accessions	Number of flowering and fruiting flushes	Peak flowering Time	Peak fruiting season	Second fruiting season	Overall abundance of flowering	Flower colour
Acc. 1	2	Mid-March	Early June	Late July	Profuse	Pale yellow
Acc. 2	2	Early March	Late May	Early August	Profuse	Whitish - yellow
Acc. 3	2	Early March	Late May	Mid-August	Moderate	Pale yellow
Acc. 4	2	Early March	Late May	Mid-August	Profuse	Pale yellow
Acc. 5	2	Mid-March	Early June	Late July	Profuse	Pale yellow
Acc. 6	2	Early March	Late May	Early August	Moderate	Pale yellow
Acc. 7	2	Early-March	Early June	Late July	Profuse	Pale yellow
Acc. 8	2	Early March	Late May	Early August	Moderate	Pale yellow
Acc. 9	2	Mid-March	Early June	Mid - August	Profuse	Pale yellow
Acc. 10	2	Late March	Mid-June	Early February	Profuse	Whitish - yellow

Fruit characteristics

Table 2 represents the fruiting characteristics of different water apple accessions. It can be observed from the Table that fruit length (in cm) was highest in case of ACC-9 (8.533 cm) followed by ACC-4 (8.367 cm), ACC- ACC-7 (7.5cm) and ACC-10 (7.167 cm). A very low fruit length was observed in ACC-3 (5.5 cm) followed by ACC-6 (5.733 cm), ACC-1 (6.167 cm), ACC-2 (6.667 cm), ACC-8 (6.733 cm) and ACC-5 (6.933 cm). Fruit diameter at the basal end was highest in ACC-2 (4.477 cm) followed by ACC-4 (4.423 cm), ACC-9 (4.213 cm), ACC-7 (3.877 cm), ACC-10 (3.807 cm), ACC-8 (3.730 cm), ACC-5 (3.517 cm), ACC-1 (3.387 cm) and ACC-6 (3.117 cm).

The fruit shape was pear shaped (pyriform) in all accessions except ACC-2, ACC-3 and ACC-6 where the fruit shape was bell shaped. The average weight of 10 fruits was maximum in case of ACC-9 (138.667 g) followed by ACC-4 (137.500 g), ACC-7 (112.767 g), ACC-10 (104.833 g), ACC-5 (102.800 g). A very low fruit weight per 10 fruits were observed in ACC-3 (63.967 g) followed by ACC-6 (65.967 g), ACC-1 (82.133 g), ACC-8 (96.333 g) and ACC-2 (99.297 g). The fruits rarely have seeds but the fruits of ACC-6 have an average of 1 seeds per 10 fruits. This is according to finding of Wills *et. al*., (1986) [9] who reported presence of 0-4 seeds per fruit.

The fruits in all accessions have a considerably high pulp percentage and edible part. Highest pulp percentage was observed in ACC-4 (94%) followed by ACC-9 (93%), ACC-8 (92.333 %) and ACC- 1 (92.667 %). A comparatively lower percentage of pulp was observed in ACC-3 (86 %) followed by ACC-6 (86.33 %), ACC-2 (88.667 %) and ACC-5 (88.667 %). Fruit colour was whitish yellow in ACC-1, ACC-3, ACC-5, ACC-8 and ACC-9; yellowish white in ACC-4 and ACC-6; pinkish-white colour in ACC-2, ACC-7 and ACC-10. This is according to the findings of Donadio *et. al*., (1998) [10].

Table 2 Fruiting characteristics of different water apple accessions

Accessions	Fruit length (in cm)	Fruit diameter (in cm)	Average weight of 10 fruits (in g)	Seeds per fruit	Edible part percentage (%)	Fruit shape	Fruit colour
Acc. 1	6.167	3.387	82.133	0	92.667	Pyriform	Whitish yellow
Acc. 2	6.667	4.477	99.297	0	88.667	Bell shaped	Pinkish white
Acc. 3	5.500	3.050	63.967	0	86.000	Bell shaped	Whitish yellow
Acc. 4	8.367	4.423	137.500	0	94.000	Pyriform	Yellowish white
Acc. 5	6.933	3.517	102.800	0	88.667	Pyriform	Whitish yellow
Acc. 6	5.733	3.117	65.967	1	86.333	Bell shaped	Yellowish white
Acc. 7	7.500	3.877	112.767	0	89.333	Pyriform	Pinkish white
Acc. 8	6.733	3.730	96.333	0	92.333	Pyriform	Whitish yellow
Acc. 9	8.533	4.213	138.667	0	93.000	Pyriform	Whitish yellow
Acc. 10	7.167	3.807	104.833	0	89.333	Pyriform	Pinkish white
S.Em. (±)	0.060	0.321	1.259	-	0.863	-	-
C.D. at 5%	0.177	0.952	3.741	-	2.563	-	-
C.V.	1.490	14.766	2.172	-	1.660	-	-

Bio-chemical characteristics

Bio-chemical properties of different water apple accessions are described in **Table 3**. From the table we can find that highest value of TSS was observed in Acc. 6 (5.853^{O}B) followed by Acc. 3 (5.777 ^{O}B), Acc. 9 (5.603 ^{O}B), Acc. 5 (5.557 ^{O}B), Acc. 7 (5.477 ^{O}B), Acc. 4 (5.433 ^{O}B), Acc. 8 (5.4 ^{O}B), Acc. 10 (5.37 ^{O}B), Acc. 1 (5.267 ^{O}B) and Acc. 2 (5.183 ^{O}B). Titratable acidity in the fruits showed huge variation among the 10 accessions. Highest Titratable acidity (%) was observed in Acc. 10 (1.407 %) followed by Acc. 7 (1.296 %), Acc. 2 (1.210 %) and Acc. 8 (1.090 %). A very low Titratable acidity was observed in Acc. 5 (0.680 %) followed by Acc. 1 (0.688 %), Acc. 4 (0.763 %), Acc. 6 (0.800 %), Acc. 9 (0.837 %) and Acc. 3 (0.870 %). TSS and Titratable acidity of the fruits were observed similar to that of Sonawane, (2018) [11].

Highest amount of total sugar was observed in Acc. 7 (3.233 %) followed by Acc. 10 (3.207 %) and Acc. 3 (3.180). Lower amount of total sugar was observed in Acc. 8 (1.813 %) followed by Acc. 6 (1.983 %), Acc. 4 (2.063 %), Acc. 5 (2.19 %), Acc. 9 (2.203 %), Acc. 2 (2.517 %) and Acc. (2.837 %). Highest value of reducing sugar was observed in Acc. 7 (2.337 %) followed by Acc. 10 (2.317 %) and Acc. 3 (2.303 %). Lowest value of reducing sugar was observed in Acc. 8 (0.933 %) followed by Acc. 6 (1.11%), Acc. 5 (1.31 %), Acc. 9 (1.323 %), Acc. 2 (1.61 %), Acc. 4 (1.787 %) and Acc. 1 (1.97 %). Highest amount of ascorbic acid content was observed in Acc. 7 (32.29 mg/100g) followed by Acc. 10 (32.28 mg/100g) and Acc. 2 (28.363 mg/100g). Lowest amount of ascorbic acid was observed Acc. 5 (10.647 mg/100g), Acc. 4 (11.583 mg/100g), Acc. 1 (11.650 mg/100g), Acc. 3 (14.770 mg/100g),

Acc. 6 (15.943 mg/100g), Acc. 8 (15.973 mg/100g) and Acc. 9 (16.980 mg/100g). Higher value of ascorbic acid content was observed in water apple with pinkish tinge as compared to the pure whitish – yellow fruits.

Table 3 Bio-chemical properties of different water apple accessions

Accessions	TSS (^{O}B)	Titratable acidity (%)	Total Sugar (%)	Reducing Sugar (%)	Ascorbic acid (mg/100g)
Acc. 1	5.267	0.688	2.837	1.970	11.650
Acc. 2	5.183	1.210	2.517	1.610	28.363
Acc. 3	5.777	0.870	3.180	2.303	14.770
Acc. 4	5.433	0.763	2.063	1.787	11.583
Acc. 5	5.557	0.680	2.190	1.310	10.647
Acc. 6	5.853	0.800	1.983	1.110	15.943
Acc. 7	5.477	1.296	3.233	2.337	32.290
Acc. 8	5.400	1.090	1.813	0.933	15.973
Acc. 9	5.603	0.837	2.203	1.323	16.980
Acc. 10	5.370	1.407	3.207	2.317	32.280
S.Em. (±)	0.041	0.014	0.020	0.197	0.438
C.D. at 5%	0.122	0.042	0.060	0.587	1.301
C.V.	1.294	2.511	1.388	20.116	3.983

Conclusion

Keeping in view all the above results, it was found that the Acc. 4 (Ranaghat) and Acc. 9 (Chakdah) fruits are large in size, yellowish-white colour, high percentage of edible portion, ideal amount of total and reducing sugar, perfect acid-sugar blend and have high ascorbic acid content. Fruits with such desirable characters are expected to have tremendous market demand. The germplasm Acc. 4 from Ranaghat and Acc. 9 from Chakdah can be conserved by asexual propagation. These asexually propagated quality germplasm can further be harnessed in future breeding programs and variety development.

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