Evaluation of Morphological Traits in Annona Hybrids

Abstract

This study, conducted at the Experimental Farm of the Indian Institute of Horticultural Research in Bangalore, India, from 2020 to 2023, evaluated phenotypic diversity among progenies from the cross between 'Arka Sahan' and 'Balanagar.' Significant variability was observed in leaf, fruit, and tree characteristics, highlighting the potential for breeding improved Annona cultivars. Growth habits varied, with most progenies exhibiting a columnar or erect form, and a smaller subset showing a spreading growth habit. Leaf characteristics, including length, width, and petiole length, showed considerable variation, aligning with previous research findings. Fruit traits such as weight, length, width, peel, pulp, and seed weight also displayed substantial variation. Few Progenies consistently recorded the highest values for several traits, marking it as a prime candidate for further development. The study underscores the importance of phenotypic diversity for breeding superior Annona varieties, contributing to advancements in pomology and horticulture.

Keywords: Annona, morphological characters, progenies,variability.

Introduction

Annona, a genus within the Annonaceae family, encompasses 120 species, with six being particularly important in pomology. Despite their morphological similarities, each Annona species displays distinct characteristics in shape, size, skin texture, pulp color, and flavor, as described by Jalikop (2000). This phenotypic diversity, combined with the broad adaptability of Annona trees and consumer preference for their fruits, highlights the commercial potential of cultivating these species. Among the edible Annona species, the sugar apple (*Annona squamosa* L.), cherimoya (*A. cherimola* Mill.), and the hybrid atemoya are especially significant and economically important in various tropical and subtropical regions, according to Batten (1990) and *Pena et al.* (2002). Cherimoya is commercially cultivated in countries such as Chile, Ecuador, Colombia, Australia, Spain, and California (Ludders, 2002). The sugar apple is notable in tropical regions including South America, Mexico, China, Africa, Egypt, the West Indies, and India, as noted by Morton (1987) and Jalikop (2000).

Globally, hybridization efforts within the Annona genus are concentrated in four research groups located in Australia, America, Israel, and India, as documented by Zill and Mahdeem (1998) and Kumar and Jalikop (2000). Within our Annona breeding program, a notable recombinant known as 'Arka Sahan,' resulting from the cross between A. atemoya and A. squamosa, has gained commercial significance (Jalikop and Kumar, 2007, 13-16). The objective of this study was to generate progeny from the cross between 'Arka Sahan' and 'Balanagar,' aiming to investigate the segregation patterns of tree and fruit traits in hybrids and to identify self-fruitful progenies of Annona.

Material and Methods

The research was conducted from 2020 to 2023 at the Experimental Farm of the Indian Institute of Horticultural Research in Bangalore, India. The farm, located at an elevation of 890 meters above sea level in the mild tropics (13°58' N, 77°37' E), features sandy clay loam soils classified as alfisols. Progenies were derived from 15-year-old trees of Arka Sahan and Balanagar, and the experiment involved 8-year-old Annona progenies. A total of 30 progenies were selected for the study. Due to the lack of a descriptor list for A. squamosa, the descriptor list of *A. cherimola* Mill. (Cherimoya), compiled by the International Plant Genetic Resources Institute (IPGRI, 2008), was used. The morphological descriptors of these 30 hybrids were measured and analyzed in this study.

Data analysis

The data collected on individual characteristics were tabulated and subjected to statistical analysis using descriptive methods with 30 selected progenies. Observations were made on each plant based on the descriptor list for *A. cherimola* published by IPGRI (2008), which included both quantitative and visual characteristics. Non-parametric data were converted to scales as proposed by IPGRI in the descriptor for *A. cherimola* (IPGRI, 2008).

Result and discussion

A wide range of variability was observed in various leaf, fruit, and tree characteristics, including leaf shape, fruit length, and fruit weight. Among the progeny resulting from the cross between 'Arka Sahan' and 'Balanagar,' the majority (21 out of 30 progenies) exhibited a columnar

or erect growth habit, while 9 progenies displayed a spreading growth habit. Additionally, 24 progenies had an ovate leaf shape, while 6 progenies exhibited a spreading growth habit. This variability in growth patterns is consistent with findings from previous research on progenies of interspecific crosses of Annona (Jalikop, 2010).In terms of plant height, the progenies ranged from 1.7 to 3.1 meters. Leaf characteristics showed considerable variation: leaf length ranged from 4.6 to 11.6 cm, leaf width varied from 3.0 to 5.1 cm, and petiole length ranged from 1.0 to 2.1 cm. The results for leaf size, in terms of both length and width, were found to be in agreement with previous research findings by Thakur and Singh (1967).This detailed observation of leaf and growth characteristics among the progenies highlights the significant phenotypic diversity within the hybrids. Such diversity is critical for selecting desirable traits for breeding programs aimed at improving Annona cultivars.

Table 1 Morphological characteristics of Annona progenies

Sl. no	Progeny	Spreading habit	Leaf shape	Plant height (m)	Leaf length (cm)	Leaf width (cm)	Petiole length (cm)
1	1\6	Erect	Ovate	2.8	13.7	5.6	2.1
2	1\8	Spreading	Elliptic	2.2	14.9	5.9	1.5
3	1\9	Spreading	Ovate	2.5	14.2	5.7	2.1
4	2\2	Erect	Ovate	1.8	16.1	7.8	2.1
5	2\3	Erect	Elliptic	2.7	11.6	5.1	1.6
6	2\7	Erect	Elliptic	2.9	13.8	5.9	1.7
7	2\11	Erect	Ovate	2.6	16.2	7.2	1.0
8	2\15	Spreading	Ovate	2.2	13.1	6.2	1.4
9	2\16	Erect	Ovate	2.2	15.5	5.5	1.3
10	3\5	Erect	Ovate	2.6	12.9	6.0	1.0
11	3\10	Erect	Ovate	2.5	12.9	5.4	1.9
12	3\13	Erect	Ovate	1.9	16.0	6.7	1.4
13	3\14	Erect	Ovate	1.8	13.4	5.8	2.1
14	4\6	Erect	Elliptic	2.4	11.8	5.2	1.8
15	4\14	Spreading	Ovate	1.7	11.9	5.5	1.4
16	5\2	Erect	Elliptic	1.8	14.5	6.1	1.5
17	5\4	Spreading	Ovate	3.1	13.4	5.3	1.2
18	6\4	Erect	Ovate	1.8	12.9	5.7	1.2
19	6\8	Spreading	Ovate	2.8	15.4	5.7	1.6
20	6\14	Erect	Ovate	2.5	13.5	6.3	1.5
21	6\15	Spreading	Ovate	3.1	15.0	7.2	2.1
22	6\16	Erect	Elliptic	3.1	15.1	8.1	1.6

23	7\11	Erect	Ovate	2.4	12.7	5.4	1.8
24	8\11	Spreading	Ovate	2.4	16.2	7.7	1.5
25	8\17	Erect	Ovate	2.4	15.4	7.4	1.4
26	8\18	Erect	Ovate	2.8	15.2	6.7	1.1
27	9\8	Spreading	Ovate	2.3	14.6	5.5	1.4
28	10\12	Erect	Ovate	2.2	15.7	6.8	1.7
29	10\16	Erect	Ovate	2.1	14.7	7.7	1.1
30	10\19	Erect	Ovate	2.3	12.0	5.2	1.7
	Mean	**-**	**-**	**2.39**	**14.14**	**6.21**	**1.56**
	C.V	**-**	**-**	**16.74**	**9.97**	**14.33**	**21.15**
	S. E.	**-**	**-**	**0.07**	**0.25**	**0.16**	**0.06**
	Range	**-**	**-**	**1.7 – 3.1**	**4.6 – 11.6**	**3.0 – 5.1**	**1.0 – 2.1**

The data regarding fruit characteristics, including fruit weight, length, width, peel, pulp, and seed weight, are presented in Table 2. The average fruit weight among the progenies ranged from 40.0 to 429.0 grams. Specifically, the fruit length varied from 2.8 to 9.0 cm, with progeny 5/2 recording the maximum fruit length of 9.0 cm, and progeny 4/6 having the minimum length of 2.8 cm.Fruit width exhibited a range of 2.9 to 7.5 cm, where progeny 5/2 again showed the maximum width of 7.5 cm, while progeny 2/2 had the minimum width of 2.9 cm. The pedicel weight ranged from 0.65 to 1.71 grams, with progeny 7/11 having the maximum pedicel weight of 1.71 grams and progeny 6/15 showing the minimum weight of 0.65 grams.In terms of peel weight, the values ranged from 21.5 to 182.5 grams. The highest peel weight was observed in progeny 5/2 at 182.5 grams, and the lowest was in progeny 3/5 at 21.5 grams. The pulp weight varied significantly, ranging from 11.3 to 230.6 grams. Progeny 5/2 had the highest pulp weight of 230.6 grams, whereas progeny 4/6 had the lowest pulp weight of 11.3 grams.Seed weight also showed considerable variation, ranging from 1.0 to 14.5 grams. The highest seed weight was recorded in progeny 5/2 at 14.5 grams, and the lowest was in progeny 2/2 at 1.0 gram. The results presented in Table 2 align with the findings of previous studies by *Agustin et al.* (2006), *Dikshit et al.* (2008), and Rao and Subramanyam (2011).This detailed analysis of fruit characters highlights the substantial variability within the progenies, which is crucial for selecting and breeding Annona cultivars with desirable fruit traits. Such data are essential for developing improved varieties with better commercial and nutritional value.

Table 2 Fruits and yield traits of Annona progenies

Sl. no	Progeny	Average fruit weight (g)	Fruit length (cm)	Fruit width (cm)	Pedicel weight (cm)	Peel weight (cm)	Pulp weight (cm)	Seed weight (cm)
1	1\6	108	5.3	5.0	1.22	42.0	62.3	2.5
2	1\8	178	6.7	5.3	1.44	70.0	102.1	4.5
3	1\9	174	6.5	4.5	0.81	72.0	99.2	2.0
4	2\2	41	3.0	2.9	1.06	24.0	14.9	1.0
5	2\3	147	5.3	5.8	1.58	70.0	71.9	3.5
6	2\7	80	5.0	5.0	1.07	32.0	36.9	10.0
7	2\11	166	6.5	5.0	1.43	68.0	92.6	4.0
8	2\15	162	6.8	5.8	1.38	46.0	110.6	4.0
9	2\16	136	6.6	5.0	1.50	60.5	72.0	2.0
10	3\5	46	4.0	3.5	1.07	21.5	21.9	1.5
11	3\10	56	4.5	4.0	1.33	28.5	23.2	3.0
12	3\13	138	6.6	5.0	1.41	57.0	76.6	3.0
13	3\14	119	5.5	4.3	1.11	54.0	62.9	1.0
14	4\6	40	2.8	3.0	1.16	26.5	11.3	1.0
15	4\14	185	5.5	7.0	1.47	69.0	109.0	5.5
16	5\2	429	9.0	7.5	1.39	182.5	230.6	14.5
17	5\4	132	5.3	5.1	1.30	56.5	69.2	5.0
18	6\4	153	5.3	6.0	1.61	66.5	79.9	5.0
19	6\8	121	5.3	5.1	1.30	39.0	77.7	3.0
20	6\14	69	3.5	4.5	1.22	36.0	29.3	2.5
21	6\15	130	5.4	5.7	0.65	41.5	83.4	4.5
22	6\16	128	5.2	5.0	1.26	48.0	74.2	4.5
23	7\11	119	5.2	5.0	1.71	49.0	62.3	6.0
24	8\11	90	5.0	4.4	1.25	38.0	48.8	2.0
25	8\17	83	5.2	4.9	1.29	37.0	43.2	1.5
26	8\18	107	5.0	5.0	1.41	47.0	56.1	2.5
27	9\8	140	6.0	4.8	1.61	62.0	67.4	9.0
28	10\12	107	4.9	5.0	1.13	43.0	60.9	2.0
29	10\16	106	5.5	4.8	1.21	48.0	54.8	2.0
30	10\19	221	6.8	6.5	1.64	85.0	132.4	2.0
	Mean	**130.66**	**5.44**	**5.0**	**1.30**	**54.0**	**71.2**	**3.8**
	C.V	**54.91**	**22.61**	**19.80**	**17.69**	**53.89**	**59.00**	**77.63**
	S. E.	**13.10**	**0.22**	**0.18**	**0.04**	**5.31**	**7.67**	**0.53**
	Range	**40 - 429**	**2.8 - 9.0**	**2.9 - 7.5**	**0.65 - 1.71**	**21.5-182.5**	**11.3 - 230.6**	**1.0 -14.5**

Conclusion

This study, conducted at the Experimental Farm of the Indian Institute of Horticultural Research in Bangalore, India, from 2020 to 2023, revealed significant phenotypic diversity among the progenies resulting from the cross between 'Arka Sahan' and 'Balanagar.' The

observed variability in leaf, fruit, and tree characteristics underscores the potential for selecting and breeding improved Annona cultivars.This detailed analysis highlights the substantial phenotypic variability within the progenies, which is crucial for breeding Annona cultivars with enhanced commercial and nutritional value. The insights gained from this study will aid in the selection and development of superior Annona varieties, contributing to advancements in pomology and horticulture.

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