International Journal of Plant & Soil Science

Volume 38, Issue 9, Page 153-157, 2026; Article no.IJPSS.164302
ISSN: 2320-7035

Evaluation of Aonla Germplasm for Growth and Yield Attributes under Semiarid Conditions of Haryana, India

Sushil Sharma [a], Suresh Kumar [a], Prince [a], Vikas Kumar Sharma [a], Akshay Mehta [a*] and Aman Kumar [a]

[a] Department of Horticulture, CCS Haryana Agricultural University, Hisar, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/ijpss/2026/v38i96276

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://pr.sdiarticle5.com/review-history/164302

Original Research Article

Received: 27/06/2026
Accepted: 18/08/2026
Published: 20/08/2026

Abstract

A field study was conducted to evaluate the growth and yield performance of aonla germplasm under the semi-arid conditions of Hisar, Haryana. The investigation was carried out at the experimental orchard of the Department of Horticulture, CCS Haryana Agricultural University, Hisar, from 2018–19 to 2021–22. Five aonla cultivars, namely NA-4, NA-5, NA-7, NA-10 and Chakaiya, were evaluated in a randomised block design with three replications. Growth parameters included plant height, plant spread in the north–south and east–west directions, and plant girth, while yield attributes included fruit length, fruit breadth, fruit weight and fruit yield per plant. The pooled results showed clear variability among the evaluated cultivars. Chakaiya recorded the maximum plant height of 9.15 m and the highest plant spread in both north–south and east–west directions, measuring 9.10 m and 9.20 m, respectively. The maximum plant girth was recorded in NA-10 at 98.92 cm. Among fruit traits, NA-4 recorded the highest fruit length of 34.36 mm, while Chakaiya recorded the highest fruit breadth of 35.49 mm and fruit weight of 31.03 g. The highest fruit yield was recorded in NA-10 at 103.21 kg per plant, followed by NA-7 at 93.65 kg per plant. The findings indicate cultivar-level variability in the growth and yield attributes of aonla under Hisar conditions.

Keywords: Aonla; hisar; consecutive; yield; chakaiya.

**Corresponding author: E-mail: akshayrock431@gmail.com;*

Cite as: *Sharma, S., Kumar, S., Prince, Sharma, V. K., Mehta, A., & Kumar, A. (2026). Evaluation of Aonla Germplasm for Growth and Yield Attributes under Semiarid Conditions of Haryana, India. International Journal of Plant & Soil Science, 38(9), 153–157. https://doi.org/10.9734/ijpss/2026/v38i96276*

1. Introduction

Aonla (Emblica officinalis Gaertn.), or Indian gooseberry, is the oldest minor fruit of Indian origin and a significant fruit crop belonging to the family Euphorbiaceae. It is grown throughout the nation under a variety of agroclimatic conditions (Tiwari *et al*., 2007; Ghosh *et al*., 2009). The plants are also commonly found in mixed deciduous forests of India, ascending to 1300 m on hills, and occur naturally in other tropical countries of the world (Tripathi *et al*., 2018). A significant fruit of the twenty-first century, aonla is tough, drought-resistant, prolific and profitable even with little care. Aonla trees are hardy in nature, adapt well to varying soil conditions, have low water requirements and exhibit salt tolerance (Chaudhary *et al*., 2018). Its high productivity, nutritional and medicinal qualities, and appropriateness for processing a variety of value-added products make it a valuable crop (Pathak, 2003). The wide adaptation of aonla to rainfed and semi-arid environments has also been emphasised in cultivar characterisation and genotype-evaluation studies, which have reported measurable variability in vegetative, fruiting and quality traits under limited-irrigation or semi-arid conditions (A. K. Singh *et al*., 2015; A. K. Singh *et al*., 2016; N. Singh *et al*., 2021).

Recent studies have further documented genotype-level variability in aonla through physico-chemical and molecular characterisation, supporting systematic germplasm evaluation for selection and improvement (Kumar *et al*., 2025; Kapoor *et al*., 2023; Sharma *et al*., 2025; Wang *et al*., 2025).

Aonla is a rich source of protein (2.187%), carbohydrate (7.11%), dietary fibre, vitamin C, iron, calcium, phosphorus, moisture content and ascorbic acid (Nimse & More, 2018). Aonla is the richest source of vitamin C among all fruits after the Barbados cherry. The aonla fruit contains about three times more protein and 160 times more vitamin C than an apple (Meena *et al*., 2014). It is referred to as "Amrit Phal" and "Wonder Drug" because of its significance and therapeutic applications. Chavanprash, Triphala, Amlaplex, Amritkalash, Trilax, Neutrale and Tylophora plus all contain it as a key component. It finds a special mention in the ancient Indian text 'Ayurveda' by Sushruta, the father of ancient medicine, during 1500-1300 BC (Pandey *et al*., 2025). Fruits are commonly used for making preserve (murabba), pickle, candy, jelly, sauce, dried chips, etc. Aonla is a valuable fruit crop in many parts of the world because of its cultural, nutritional, medicinal and economic significance (A. K. Singh *et al*., 2019). Because fruit size, pulp proportion, acidity, total soluble solids and ascorbic acid differ among cultivars and environments, germplasm evaluation is relevant not only for yield selection but also for identifying genotypes suitable for fresh consumption and processing purposes (Ghosh *et al*., 2009; Tripathi *et al*., 2018; Jegadeeswari *et al*., 2024). A recent peer-reviewed synthesis likewise documented substantial cultivar-level variation in morphological, nutritional and phytochemical characteristics, reinforcing the value of genotype-specific evaluation for end-use selection (Avinash *et al*., 2024).

A recent review also summarised the nutritional and phytochemical constituents of *Phyllanthus emblica* and its established traditional applications (Swathi *et al*., 2023).

NA-4, commonly known as Kanchan, is a prominent mid-season selection variety of aonla developed from a chance seedling of Chakaiya. NA-5 (also known as Krishna) is an improved commercial variety of aonla developed as a seedling selection from Banarasi. NA-7 is a mid-season, abundant and regular-bearing variety selected as a seedling from Francis. NA-10 is a prominent, early-maturing commercial variety of aonla selected as a chance seedling of Banarasi. Chakaiya is a traditional, heavy-bearing aonla variety known for its spreading tree habit, medium-sized flattened fruits and high suitability for pickles. In nature, considerable variation with respect to fruit shape and size, yield and earliness of bearing is evident in this crop. The advantages of these variations can be used to evolve superior selections. Collection and evaluation are the best procedures for evolving suitable germplasm for a particular area of its natural existence. Keeping this in view, this experiment was planned to study the "Evaluation of Aonla Germplasm for Growth and Yield Attributes Under Semiarid Conditions of Haryana" with the objective of collecting new germplasm and evaluating the performance of the plants. Previous studies on aonla varieties have shown that cultivar-specific morphology and fruit characters can support varietal identification and selection for future improvement programmes (A. K. Singh *et al*., 2015; B. Singh *et al*., 2012; N. Singh *et al*., 2021).

Despite the reported cultivar-level variation in aonla, a direct multi-year comparison of NA-4, NA-5, NA-7, NA-10 and Chakaiya for both vegetative growth and fruit-yield attributes under the semi-arid conditions of Hisar, Haryana, remains necessary within the scope of the present investigation. This location-specific evaluation is intended to clarify the relative performance of these cultivars under the tested environment.

Accordingly, the objective of the present study was to evaluate the growth and yield performance of NA-4, NA-5, NA-7, NA-10 and Chakaiya under the semi-arid conditions of Hisar, Haryana.

2. Materials and Methods

The present investigation was conducted at the experimental orchard of the Department of Horticulture, CCS Haryana Agricultural University, Hisar, during the period 2018-19 to 2021-22. Hisar falls within a typical semi-arid climatic region characterised by scorching, arid summers and extremely frigid winters. This area experiences substantial fluctuations in temperature, in terms of both monthly maximum and minimum readings, during the summer and winter months. In summer, from May to June, temperatures soar to a peak of approximately 48°C, while winter brings frigid conditions, with temperatures occasionally dropping to the freezing point in December and January. Rainfall exhibits significant variability in both its total quantity and distribution. Of the overall annual rainfall, which amounts to about 450 mm, a substantial 80% occurs during the monsoon season from July to September. There are sporadic, light showers from December to February due to western disturbances. Rainfall in this region is notably unreliable, with annual fluctuations ranging between 20-30% and seasonal variations spanning 30-50%. Five different cultivars of aonla were collected and evaluated, i.e., NA-4, NA-5, NA-7, NA-10 and Chakaiya, with three replications each, following a

randomised block design. The observations included plant height (m), plant spread (N-S), plant spread (E-W), plant girth (cm), fruit length (mm), fruit breadth (mm), fruit weight (g) and fruit yield (kg/plant).

Plant Height (m): Plant height was measured in metres using a graduated measuring pole at the start and end of the experiment. Plant height was measured from ground level to the highest reachable tip.

Plant spread (m): Plant canopy was measured using a graduated measuring tape as the distance between the points to which most of the branches had grown in both directions (E-W and N-S). It was estimated in metres at the start and end of the experiment.

Plant Girth (cm): To calculate the girth (circumference) of a fruit, a measuring tape was used, and the value was expressed in centimetres (cm).

Fruit Length and Breadth (mm): Observations on fruit size in terms of length (mm) and diameter (mm) were recorded using a Vernier caliper at the time of fruit harvesting. The average length and diameter were then calculated and expressed in millimetres (mm).

Fruit Weight (g): Five randomly selected fruits from the tagged branch of the tree were picked and weighed on a top-pan electronic balance. The average fruit weight was calculated by dividing the total fruit weight by the total number of fruits taken and was expressed in grams (g).

Fruit Yield (kg/plant): To calculate total fruit yield, the total number of fruits per tree was multiplied by the average fruit weight, and the value was expressed in kilograms (kg/tree).

3. Results and Discussion

Variation was observed in the growth and yield of aonla germplasm collected from different sites (Table 1). The pooled data from 2018-19 to 2021-22 show that the average plant height of aonla was highest in cultivar Chakaiya (9.15 m), followed by NA-7 (7.62 m), while the lowest plant height (6.56 m) was recorded in cultivar NA-4. The highest plant spread in the N-S and E-W directions was recorded in Chakaiya (9.10 m and 9.20 m, respectively), and the minimum plant spread in the N-S and E-W directions was found in cultivar NA-10 (6.72 m and 7.15 m). The maximum plant girth (98.92 cm) was observed in NA-10, followed by NA-4 (85.02 cm), while the minimum plant girth was found in NA-7 (67.03 cm). The observed differences in plant height, canopy spread and girth suggest cultivar-specific vegetative expression under the semi-arid conditions of Hisar. Similar studies have reported that aonla genotypes and varieties differ substantially in vegetative habit and fruit characters under semi-arid or rainfed conditions, indicating that local evaluation is necessary before recommending a cultivar for a specific production environment (A. K. Singh *et al*., 2015; A. K. Singh *et al*., 2016; N. Singh *et al*., 2021). Field evaluation of diverse aonla accessions has similarly shown significant variation in plant height, canopy spread, girth, fruit weight and related quality traits, supporting the use of multi-trait assessment in germplasm selection (Pandey *et al*., 2016).

Table 1. Growth parameters of different cultivars of aonla

Germplasm	Plant Height (m)	Plant Spread (N-S)	Plant Spread (E-W)	Plant Girth (cm)
Chakaiya	9.15	9.10	9.20	73.30
NA-4	6.56	6.42	6.35	85.02
NA-5	7.20	8.10	8.02	83.43
NA-7	7.62	7.75	8.68	67.03
NA-10	7.40	6.72	7.15	98.92
CD (p = 0.05)	0.17	0.26	0.16	3.91

Similarly, variation was observed in the yield of aonla germplasm collected from different sites. Table 2 shows the yield parameters of different cultivars of aonla. On the basis of pooled data from four years (2018-19 to 2021-22), fruit length and breadth were found to be highest in NA-4 (34.36 mm) and Chakaiya (35.49 mm), respectively, whereas the minimum fruit length was found in NA-10 (29.64 mm) and the minimum fruit breadth was found in NA-5 (29.34 mm). The maximum fruit weight was observed in cultivar Chakaiya (31.03 g), and the minimum fruit weight was observed in NA-7 (27.26 g). The highest fruit yield (103.21 kg/plant) was observed in NA-10, followed by NA-7 (93.65 kg), while the minimum fruit yield was observed in Chakaiya (82.24 kg/plant). The yield pattern indicates that superior vegetative size or individual fruit weight did not necessarily correspond with the highest yield per plant. This response is consistent with earlier aonla studies showing that yield depends on the combined effects of fruit retention, fruit number, fruit size and cultivar adaptation, rather than on a single growth or fruit trait alone (Ghosh *et al*., 2009; Tripathi *et al*., 2018; N. Singh *et al*., 2021). In the present study, NA-10 produced the highest fruit yield despite recording comparatively lower plant spread, which may indicate better yield efficiency under the tested conditions; however, this inference should be confirmed through wider multi-location testing before making a general recommendation. The contrast between the highest-yielding cultivar and the cultivar with the greatest individual fruit weight is also consistent with previous accession and varietal evaluations, in which yield superiority was associated with a combination of fruit number, retention and fruit traits rather than fruit weight alone (Jegadeeswari *et al*., 2024; Pandey *et al*., 2016).

Table 2. Yield parameters of different cultivars of aonla

Germplasm	Fruit length (mm)	Fruit breadth (mm)	Fruit Weight (g)	Fruit Yield (kg/plant)
Chakaiya	32.55	35.49	31.03	82.24
NA-4	34.36	33.06	27.41	89.51
NA-5	30.59	29.34	27.79	91.01
NA-7	32.21	31.50	27.26	93.65
NA-10	29.64	31.54	27.99	103.21
CD (p = 0.05)	1.35	1.51	1.82	4.12

4. Conclusion

The four-year evaluation demonstrated measurable variation among the five aonla cultivars for vegetative growth and fruit-yield attributes under the semi-arid conditions of Hisar. Chakaiya recorded the maximum plant height and the greatest canopy spread in both measured directions, together with the highest fruit breadth and individual fruit weight. NA-10 recorded the maximum plant girth and produced the highest fruit yield per plant, while NA-7 ranked second for yield. NA-4 produced the greatest fruit length among the evaluated cultivars. These pooled observations indicate that superior vegetative growth or individual fruit weight did not necessarily correspond with the highest fruit yield per plant. Under the conditions of the present study, NA-10 may therefore be considered promising for yield performance, whereas Chakaiya showed comparatively strong vegetative growth and selected fruit-size attributes. The findings are specific to the tested environment, and evaluation across wider locations and management conditions would be useful before formulating broader cultivation recommendations.

5. Limitation

The study was conducted at a single experimental location in Hisar and included five aonla cultivars evaluated over four years. Consequently, the observed cultivar responses represent performance under the tested semi-arid environment and should not be generalised to other agroclimatic regions without further validation. The assessment was restricted to the reported growth and yield attributes. Multi-location evaluation under wider management conditions would strengthen the basis for broader cultivar recommendations.

Declaration of AI Use

This manuscript was prepared through the intellectual contributions of the author(s) to the study design, data analysis, interpretation of results, and scholarly content. Grammarly and ChatGPT were used solely to assist with grammatical refinement and reference formatting during manuscript revision. The author(s) accept full responsibility for the accuracy, integrity, and final content of the manuscript.

Competing Interests

Authors have declared that they have no known competing financial interests or non-financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Avinash, P. G., Hamid, Shams, R., Dash, K. K., Shaikh, A. M., Ungai, D., Harsányi, E., Suthar, T., & Kovács, B. (2024). Recent insights into the morphological, nutritional and phytochemical properties of Indian gooseberry (*Phyllanthus emblica*) for the development of functional foods. *Plants, 13*(5), 574. https://doi.org/10.3390/plants13050574

Chaudhary, M., Singh, D. P., Singh, J. P., & Mishra, K. K. (2018). Effect of foliar application of PGRs and mineral nutrients on fruiting behaviour, growth and yield of aonla cv. NA-7. *Journal of Pharmacognosy and Phytochemistry, 7*(4), 2714–2718. https://www.phytojournal.com/archives/2018.v7.i4.5353/effect-of-foliar-application-of-pgrs-and-mineral-nutrients-on-fruiting-behaviour-growth-and-yield-of-aonla-cv-na-7

Ghosh, S. N., Bera, B., Roy, S., Kundu, A., & Roy, S. K. D. (2009). Effect of nutrients and plant growth regulators on fruit retention, yield and physico-chemical characteristics in aonla cv. NA-10. *Journal of Horticultural Sciences, 4*(2), 164–166. https://doi.org/10.24154/jhs.v4i2.537

Jegadeeswari, V., Vijayalatha, K. R., Padmadevi, K., & Kalaivani, J. (2024). Evaluation of aonla varieties for yield and quality under semi-arid conditions. *Journal of Advances in Biology & Biotechnology, 27*(6), 781–786. https://doi.org/10.9734/jabb/2024/v27i6939

Kapoor, B., Sharma, M., Sharma, R., Zadokar, A., Thakur, A., Sharma, P., Kumar, S., Rozar, K. P., Kumar, K. S., Hegde, N., & Pandey, D. (2023). De novo transcriptome profiling and development of novel secondary metabolites based genic SSRs in medicinal plant *Phyllanthus emblica* L. (Aonla). *Scientific Reports, 13*, 17319. https://doi.org/10.1038/s41598-023-44317-x

Kumar, S., Raj, K., Tigga, A., Prajapati, C. S., Shekhawat, C., Pradhan, R., Verma, S., & Verma, R. S. (2025). Evaluation of physico-chemical attributes of aonla (*Emblica officinalis* L.) genotypes under Eastern Uttar Pradesh agro-climatic conditions. *Journal of Advances in Biology & Biotechnology, 28*(4), 607–612. https://doi.org/10.9734/jabb/2025/v28i42220

Meena, D., Tiwari, R., & Singh, O. P. (2014). Effect of nutrient spray on growth, fruit yield and quality of aonla. *Annals of Plant and Soil Research, 16*(3), 242–245.

https://gkvsociety.com/control/uploads/Effect%20of%20nutrient%20spray%20on%20growth%2C%20fruit%20yield%20and%20quality%20of%20aonla.pdf

Nimse, S. B., & More, D. R. (2018). Evaluation of physical and nutritional properties of aonla. *Journal of Pharmacognosy and Phytochemistry, 7*(2), 3733–3735. https://www.phytojournal.com/archives/2018.v7.i2.4127/evaluation-of-physical-and-nutritional-properties-of-aonla

Pandey, D., Pandey, G., Pandey, A., & Dube, A. (2016). Field evaluation of Indian gooseberry (*Emblica officinalis*) accessions for yield, fruit quality and antioxidant potential. *The Indian Journal of Agricultural Sciences, 86*(11), 1495–1498. https://doi.org/10.56093/ijas.v86i11.62942

Pandey, D., Singh, S. K., Poojan, S., & Shukla, S. (2025). Annual crop management practices in aonla for subtropical region. *Indian Horticulture, 70*(1), 20–23. https://epubs.icar.org.in/index.php/IndHort/article/view/156408

Pathak, R. K. (2003). *Status report on genetic resources of Indian gooseberry-aonla (Emblica officinalis Gaertn.) in South and Southeast Asia*. IPGRI Office for South Asia, National Agriculture Science Centre.

Sharma, M., Sharma, R., Zadokar, A., Thakur, A., Sharma, P., & Kumar, S. (2025). Germplasm characterization of commercial and wild gooseberry (*Phyllanthus emblica* L.) through physico-chemical and molecular attributes: Useful insights for genetic resource management. *Genetic Resources and Crop Evolution, 72*, 8025–8048. https://doi.org/10.1007/s10722-025-02439-3

Singh, A. K., Singh, P. P., Singh, S., Bhargava, R., & Makwana, P. (2016). Variability in morphological and physico-chemical traits of aonla (*Emblica officinalis*) genotypes collected from north-eastern region of India. *The Indian Journal of Agricultural Sciences, 86*(8), 992–997. https://doi.org/10.56093/ijas.v86i8.60510

Singh, A. K., Singh, S., & Makwana, P. (2015). Characterization of aonla (*Emblica officinalis*) varieties under zero irrigation semi-arid conditions. *The Indian Journal of Agricultural Sciences, 85*(10), 1365–1369. https://doi.org/10.56093/ijas.v85i10.52308

Singh, A. K., Singh, S., Saroj, P. L., Mishra, D. S., Singh, P. P., & Singh, R. K. (2019). Aonla (*Emblica officinalis*) in India: A review of its improvement, production and diversified uses. *The Indian Journal of Agricultural Sciences, 89*(11), 1773–1781. https://doi.org/10.56093/ijas.v89i11.95288

Singh, B., Uniyal, A. K., Rawat, J. S. M., & Rana, D. K. (2012). Estimation of genetic variability in *Phyllanthus emblica* L.: Towards a contribution in sustainable rural development. *Journal of Horticulture and Forestry, 4*(5), 92–95. https://doi.org/10.5897/JHF11.074

Singh, N., Kumar, M., & Sharma, J. R. (2021). Evaluation of aonla (*Phyllanthus emblica*) genotypes under semi-arid conditions. *The Indian Journal of Agricultural Sciences, 91*(12), 1778–1782. https://doi.org/10.56093/ijas.v91i12.120806

Swathi, V., Kumar, J. N. S., Prasad, P. D., Salma, S., Rani, M., Aslam, S. A., & Tipsy, K. (2023). A review on *Phyllanthus emblica*: Anti-inflamatory and antioxidant effect. *Uttar Pradesh Journal of Zoology, 44*(6), 23–32. https://doi.org/10.56557/upjoz/2023/v44i63451

Tiwari, A. K., Mishra, P., & Tiwari, S. C. (2007). Biology of *Deudorix isocrates* Fabr. on aonla (*Emblica officinalis*). *Annals of Plant Protection Sciences, 15*(2), 335–337.

Tripathi, V. K., Pandey, S. S., Kumar, A., Dubey, V., & Tiwari, P. (2018). Influence of foliar application of gibberellic acid, calcium and boron on fruit drop, yield and quality attributes of aonla (*Emblica officinalis*) cv. NA 7. *The Indian Journal of Agricultural Sciences, 88*(11), 1784–1788. https://doi.org/10.56093/ijas.v88i11.84931

Wang, J., Ali, M. M., Wu, Y., Zhang, G., Zhang, X., Xie, L., Zhang, L., Chen, J., Li, T., & Chen, F. (2025). Genetic diversity and comprehensive evaluation of physicochemical traits in *Phyllanthus emblica* L. for breeding and resource utilization. *BMC Plant Biology, 25*, 1187. https://doi.org/10.1186/s12870-025-07161-x

Peer-review history:
The peer review history for this paper can be accessed here:
https://pr.sdiarticle5.com/review-history/164302