



# Impact of Integrated Nutrient Management of Biochemical Attributes on Aonla (*Ebmblica officinallis* Garetn.)

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## Authors' contributions

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

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## ABSTRACT

The investigation was carried out with the aim of knowing the effect of integrated nutrient management on the fruiting of *Aonla* cv. Francis. The Experiment was conducted in two consecutive years. The experiment comprised of thirteen treatments, with three replications with randomized block design. The study revealed the Ascorbic acid, acidity, Organic carbon, Available nitrogen, Available phosphorus, and available potassium per cent for both year was noted maximum with the use of T<sub>7</sub>, which was at par with T<sub>4</sub>, T<sub>5</sub>, T<sub>6</sub> and both treatment was significantly superior over rest of the treatment. The study concluded that applying 5% RDF + 30 kg Vermicompost+ 250 g Azotobacter+ 250g PSB, produced good quality fruit, yield and physiochemical attributes of Aonla for sustainable production.

**Keywords:** INM; ascorbic acid; acidity; attributes; aonla; available nitrogen; available phosphorus; available potash.

## 1. INTRODUCTION

“Aonla (*Emblica officinalis* Gaertn. Syn. *Phyllanthusemblica*) is indigenous fruit of the Indian subcontinent, known for its medicinal and therapeutic properties and considered a wonder fruit for the health-conscious population. The Aonla tree is native to tropical Southeast Asia, particularly central or southern India, Pakistan, Bangladesh, Sri Lanka, Malaya, Southern China and to Mascarene Islands and it is also growing naturally in Cuba, Puerto Rico, Hawaii, Florida, Iran, Iraq, Java, West Indies, Trinidad, Singapore, southern Thailand, Pakistan, Malaya and China and Panama Canal regions. In India, Aonla seedling trees are of common occurrence in the mixed deciduous dry forests ascending from sea level (Western and Eastern ghats, Aravali and Vindhyan hills) to 1300 m msl, (mean sea level) from northwest Himalayas (Jammu & Kashmir, Himachal Pradesh, Uttarakhand) to eastern Himalayas in Assam, Meghalaya, Mizoram, Manipur and Tripura. India ranks first in the production of Aonla. It occupies an area of 94 thousand hectares with a production of 1098 thousand metric tons” [1]. “In Jammu and Kashmir, Aonla is being successfully grown in Kathua, Samba, Akhnoor, parts of Udhampur and Reasi districts on an area of 1701 ha with an annual production of 3780 metric tons, respectively” [2]. “In Uttar Pradesh Aonla cultivation is maximum in nearby belt of Pratapgarh and Faizabad district. The area under the production of Aonla is 15.75 (‘000Ha), production is 63.00 (‘000MT) and productivity is about 4.0 (MT/Ha). Aonla fruit is rich in vitamin C and pectin. On average, Aonla fruit contains 82.2 per cent water, 0.5 per cent protein, 0.1 per cent fat, 14 per cent carbohydrates and 600 mg of vitamin C/ 100g of pulp. The fruit contains a chemical substance known as leuco-

anthocyanins (Polyphenol), which retards the oxidation of vitamin C. It also contains calcium, phosphorus and iron. It is a fair source of vitamin B (30 mg/100 g) and nicotinic acid (0.2 mg/ 100 g). The Aonla fruit has a calorific value of 59 per 100 g of fruit and due to its ant scorbutic, diuretic, laxative, alternative and antibiotic properties, it is regarded as high value having diverse medicinal, industrial and other applications. Many medicinal virtues have been attributed to Aonla and has been found effective in the treatment of tuberculosis of lungs, asthma, and bronchitis” [3]. “It is also beneficial for treating conjunctivitis, glaucoma, diabetes, rheumatism, diarrhoea and dysentery. It tones up the functions of all body organs and builds up health by destroying the heterogeneous elements and renewing the body's energy. It has a revitalizing effect. It is said that the great ancient sage Mini Chywan rejuvenated himself in his late 70s and regained his virility by using Aonla” [4]. “Besides, fruits are commonly used for the preparation of preserved preserves (murabba), pickle, candy, jelly, etc. It can be dried and powdered to be used subsequently. It is also used to prepare inks, hair dyes, hair oils” [5]. “Soil type, fertility and nutrient management play an important role in obtaining higher growth and yields of Aonla. Inadequate nutrition has very often been attributed as the cause of lower yields in Aonla. Due to poor physical properties of soil, it becomes very hard during season and crop suffers due to deficiency of major plant nutrients” [6]. “Crop nutrition is one of the most essential factors, which greatly affect the yield and quality of Aonla” [7]. “Fruit productivity and quality can be maintained in subsequent generation by integrated nutrient management system and contribute share in input cost of production” [8]. “Therefore, efficient use of integrated plant nutrient supply system is a prerequisite for achieving continuous advances

in productivity of fruits crops in ecologically sustainable manner” [9].

“Integrated Nutrient Management developed on principles of eco-friendly and efficient balanced fertilizer and based on optimization of nutrient supplies from all the available sources for getting pre-defined targets. Integrated nutrient supply/management (INM) is a system that helps to restore and sustain crop productivity and also absent in checking the emerging micronutrient efficiencies. INM is an aims at maintenance or adjustment of soil fertility and of plant nutrient supply to an optimum level for sustaining the desired crop productivity through optimization of benefit from all possible sources of plant nutrients in an integrated manner” [10]. “It infuses long term sustainability in the productivity level because of availability of nutrients in soil for next season crop. It also minimizes the existing gap between the nutrient removal through continuous use of chemical fertilizers and supply through slow release of fertilizers” [11].

## 2. MATERIALS AND METHODS

The present investigation was carried out at Main Experiment Station, Horticulture, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.) on 28 year-old plants of Aonla uniformly healthy and well maintained. The experiment was laid out in Randomized Block Design with 13 treatments

and replicated thrice. The climatic condition of Ayodhya district comes under the semi-arid comprising of three district seasons viz rainy or wet, winter and summer or hot. The rainy season starts from the last week of June to last September or extends up to October with an average rainfall of 1200-1300 mm. The winter season starts in November and continuous up to the first week of March with mean temperature ranging from 15-25° C. The months of December and January are very cold while January is the coldest month with a lower temperature. The temperature during summer is intense and recording a little below 45°C. The relative humidity during summer <2- varies from 35 to 60 per cent. Severe drought occurs quite frequently accompanied by very low relative humidity, sensitive and wind velocity. T<sub>1</sub>:100 % RDF (1:0.5:1: N: P: K + 10kg FYM plant<sup>-1</sup>), T<sub>2</sub>:75 % RDF + 10kg Vermicompost, T<sub>3</sub>:75 % RDF + 10kg Vermicompost+ 250g Azotobacter+ 250g PSB, T<sub>4</sub>:75 % RDF + 20kg Vermicompost, T<sub>5</sub>:75% RDF + 20kg Vermicompost + 250g Azotobacter + 250g PSB, T<sub>6</sub>:75% RDF + 30kg Vermicompost, T<sub>7</sub>:75% RDF + 30 kg Vermicompost+ 250g Azotobacter+ 250g PSB, T<sub>8</sub>:50 % RDF + 10kg Vermicompost, T<sub>9</sub>:50 % RDF + 10kg Vermicompost+ 250g Azotobacter+ 250 g PSB, T<sub>10</sub>:50 % RDF + 20kg Vermicompost, T<sub>11</sub>:50 % RDF + 20kg Vermicompost+ 250g Azotobacter+ 250g PSB, T<sub>12</sub>:50% RDF + 30kg Vermicompost, T<sub>13</sub>:50% RDF+ 30 kg Vermicompost+ 250g Azotobacter+ 250g PSB.

- 1. Acidity (%):** “The known quantity of fruit pulp (10g) was macerated and diluted in a small amount of distilled water and filtered through muscling cloth. The volume was made up to 100 ml, 5 ml aliquot was taken for titration. The acidity of fruit was estimated by titrating of the aliquot against N/10 NaOH solution using phenolphthalein as an indicator. The total titrable acidity was expressed as per cent citric acid” [12].

$$\text{Acidity (\%)} = \frac{\text{Titrate value} \times \text{Normality of NaOH} \times \text{value maintain (100 ml)} \times 64 \times 100}{\text{Aliquot Taken (5 ml)} \times \text{weight of a sample (10g)}} \times 100$$

- 2. Ascorbic acid:** “5 g fruit pulp was dissolved in 3% metaphosphoric acid and volume was made up to 100 ml. five ml aliquot was titrated against standardized 2, 6-dichloro indophenol dye. The endpoint was marked as when pink colour appeared and retained for at least 15 seconds. The ascorbic acid content was expressed as mg ascorbic acid per 100 g of pulp” (A.O.A.C., 1990).

$$\text{Ascorbic acid (mg100g of pulp)} = \frac{\text{Titrate value} \times \text{Dye factor} \times \text{Valume made up} \times 100}{\text{Aliquot of extract for estimation} \times \text{volume of sample}}$$

- 3. Organic carbon:**It was estimated by Walkley and Black (1934) rapid titration method as described by Baruah and Borthakur (1998).
- 4. Available nitrogen:**It was estimated by alkaline potassium permanganate method (Subbiah and Asija, 1956) as suggested by Baruah and Borthakur (1998).

5. **Available phosphorus:** It was estimated by Olsen's method as described by Baruah and Borthakur (1998).
6. **Available potassium:** It was estimated by Flame photometer with the use of saturation extract of soil as described by Baruah and Borthakur (1998).

**Analysis of data:** The two years data obtained during experimentation were statistically analysed as per the method given by Panse and Sukhatme (2000) and the result was evaluated at 5% level of significance.

The standard error (SEm±) for the difference of treatment means were computed as follows.

$$SEm\pm = \sqrt{\frac{2MSE}{r}}$$

Where,

MSE= Mean sum squares due to error

r= number of replications

The calculation of CD at 5% of tale value was carried out with the help of following formula.

SEm± = Standard error of the mean

CD = SEm± × t value at 5%

CD = Critical difference

### 3. RESULTS AND DISCUSSION

In the present investigation data indicated that the highest ascorbic acid and acidity percentage was recorded with the application of T<sub>7</sub> (75% RDF + 30 kg *Vermicompost*+ 250g *Azotobacter*+ 250g PSB) which was at par with T<sub>5</sub>75% RDF + 20kg

*Vermicompost* + 250g *Azotobacter* + 250g PSB and both treatment were significantly superior over rest of the treatments (Table 1). It may be due to proper supply of nutrients and induction of growth hormones in optimum amount and proportion right from starting of the experimentation to the harvest of the crop, which is found useful for sustainable production of quality fruits. The result is confirmed with the finding of Singh et al. [13,14]. The improvement in fruit quality with the application of T<sub>7</sub> was found to be better in terms of increasing the soil fertility, soil microbial & earth worm population, , yield and quality of Aonla fruits, Singh et al [15,16].

Among the treatment the maximum organic carbon, Available Nitrogen, Available phosphorus, Available potassium were recorded with the soil application of T<sub>7</sub> (75% RDF + 30 kg *Vermicompost*+ 250g *Azotobacter*+ 250g PSB ) which were found equally good with T<sub>4</sub>, T<sub>5</sub>T<sub>6</sub> and however, minimum potassium and nitrogen content the use of T<sub>1</sub> and result was found not significant. The maximum available nitrogen, phosphorus, and potassium were noted with the soil application of T<sub>7</sub> (50%NPK+50% FYM+250g each (*Azotobacter* +*Azospirillum* +PSB). The present study is practically supported with the findings of Katyal [17]. He reported that "improvement in carbon and phosphorus status enhanced nutrient availability, improved structure and reduced soil erosion. Organic matter with chemical fertilizers and their method of application help in improving the fertility, productivity, and physical condition of soil". Katyal [17] Gourishankar [18] also reported "that application of FYM along with inorganic fertilizers improve the bulk density, organic carbon content and available NPK in soil at crop harvest".

**Table 1. Effect of Integrated Nutrient Management (INM) on Acidity (%) & Ascorbic acid of Aonla**

Treatments	Acidity (%)		Ascorbic acid (mg/100g pulp)	
	2018	2019	2018	2019
T <sub>1</sub> 100 % RDF (1:0.5:1: N: P: K + 10kg FYM plant <sup>-1</sup> )	1.770	1.820	475.2	479.60
T <sub>2</sub> 75 % RDF + 10kg <i>Vermicompost</i>	1.690	1.740	491.4	495.9
T <sub>3</sub> 75 % RDF + 10kg <i>Vermicompost</i> + 250g <i>Azotobacter</i> + 250g PSB	1.470	1.520	561.60	566.80
T <sub>4</sub> 75 % RDF + 20kg <i>Vermicompost</i>	1.580	1.630	523.8	528.7
T <sub>5</sub> 75% RDF + 20kg <i>Vermicompost</i> + 250g <i>Azotobacter</i> + 250g PSB	1.400	1.440	599.4	604.9
T <sub>6</sub> 75% RDF + 30kg <i>Vermicompost</i>	1.550	1.600	540.0	545.0
T <sub>7</sub> 75% RDF + 30 kg <i>Vermicompost</i> + 250g <i>Azotobacter</i> + 250g PSB	1.360	1.410	615.60	621.30
T <sub>8</sub> 50 % RDF + 10kg <i>Vermicompost</i>	1.720	1.780	486.0	490.5
T <sub>9</sub> 50% RDF + 10kg <i>Vermicompost</i> + 250g <i>Azotobacter</i> + 250 g PSB	1.500	1.550	550.8	555.9
T <sub>10</sub> 50 % RDF + 20kg <i>Vermicompost</i>	1.640	1.700	502.2	506.8
T <sub>11</sub> 50 % RDF + 20kg <i>Vermicompost</i> + 250g <i>Azotobacter</i> + 250g PSB	1.440	1.490	572.4	577.7
T <sub>12</sub> 50% RDF + 30kg <i>Vermicompost</i>	1.610	1.660	513.0	517.8
T <sub>13</sub> 50% RDF+ 30 kg <i>Vermicompost</i> + 250g <i>Azotobacter</i> + 250g PSB	1.410	1.460	588.6	594.0
SEm ±	0.03	0.05	23.55	20.19
CD	0.10	0.15	68.73	58.93

**Table 2. Effect of Integrated Nutrient Management (INM) on Organic carbon (%), Available nitrogen, Available phosphorus and Available potassium of Aonla**

Treatments	Organic carbon (%)		Available nitrogen		Available phosphorus		Available potassium	
	2018	2019	2018	2019	2018	2019	2018	2019
T <sub>1</sub> 100 % RDF (1:0.5:1: N: P: K + 10kg FYM plant <sup>-1</sup> )	0.39	0.39	144	146	14.30	14.46	244	246
T <sub>2</sub> 75 % RDF + 10kg Vermicompost	0.39	0.42	153	160	15.15	15.84	253	260
T <sub>3</sub> 75 % RDF + 10kg Vermicompost+ 250g Azotobacter+ 250g PSB	0.45	0.48	155	164	15.35	16.23	255	264
T <sub>4</sub> 75 % RDF + 20kg Vermicompost	0.42	0.46	154	154	15.25	15.25	254	254
T <sub>5</sub> 75% RDF + 20kg Vermicompost + 250g Azotobacter + 250g PSB	0.48	0.48	168	171	16.63	16.93	268	271
T <sub>6</sub> 75% RDF + 30kg Vermicompost	0.42	0.47	155	156	15.35	15.45	255	256
T <sub>7</sub> 75% RDF + 30 kg Vermicompost+ 250g Azotobacter+ 250g PSB	0.49	0.51	172	166	17.02	16.44	272	266
T <sub>8</sub> 50 % RDF + 10kg Vermicompost	0.39	0.42	151	155	14.95	15.05	251	255
T <sub>9</sub> 50% RDF + 10kg Vermicompost+ 250g Azotobacter+ 250 g PSB	0.44	0.47	155	158	15.35	15.64	255	258
T <sub>10</sub> 50 % RDF + 20kg Vermicompost	0.40	0.44	153	164	15.15	16.24	253	264
T <sub>11</sub> 50 % RDF + 20kg Vermicompost+ 250g Azotobacter+ 250g PSB	0.46	0.48	157	155	15.54	15.35	257	255
T <sub>12</sub> 50% RDF + 30kg Vermicompost	0.45	0.46	154	155	15.25	15.35	254	254
T <sub>13</sub> 50% RDF+ 30 kg Vermicompost+ 250g Azotobacter+ 250g PSB	0.48	0.47	158	164	15.64	16.24	258	264
Sem ±	0.016	0.017	6.89	7.94	0.68	0.58	1.41	10.37
CD	0.049	0.052	NS	NS	1.98	NS	NS	NS

#### 4. CONCLUSION

On the basis of the finding, the present investigation the maximum increment in term of Ascorbic acid, acidity, organic carbon, Available nitrogen, Available phosphorus, Available potassium were noted with the soil application of T7 is maximum during the both year which was found at par with T4,T5,T6. The minimum percent incremented was noticed with the use of T1 so that it is concluded that treatment T775% RDF + 30 kg Vermicompost+ 250g Azotobacter+ 250g PSB recorded maximum yield, fruit Quality and physiochemical attribute of Aonla can be recommended to Aonla growers of Eastern Uttar Pradesh for obtaining maximum yieldwith quality fruits.It is hoped that this research will not only benefit the Aonla industries but also contribute to the broader realm of sustainable agriculture and horticulture.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

#### REFERENCES

1. Anonymous. Indian Horticulture Database, National Horticulture Board, Department of Agricultureand co-operation & farmers welfare. Government of India. Gurgaon; 2019A.
2. Anonymous. Area and production. Directorate of Horticulture, Kashmir, Jammu & Kashmir, India; 2019B.
3. Kumar R, Pathak S, Kumar A, Kumar Kumar U, Kumar DG. Studies on physico-chemical composition of Aonla fruit (*Emblicaofficinalis* L.). The Bioscan. 2016;11(4):2375-2377.
4. Wali VK, Bakshi P, Jasrotia A, Bhushan B, Bakshi M. Aonla.KUAST-Jammu. 2015;30.
5. Tripathi VK, Singh MB, Singh S. Studies on comparative compositional changes in different preserved products of amla (*Emblicaofficinalis*Gaertn.) Var. Banarasi. Indian Food Packer. 1988;42(4):60-66.
6. Mandal KK, Rajak A, Debnath S, Hasan MA. Integrated nutrient management in aonla cv. A-7 in the red lateritic region of West Bengal. Journal of Crop and Weed. 2013;9(1):121-123.
7. Mustafa MD, Pandey SK, Katara S, Pandey D, Singh A. Response of integrated nutrient management in Aonla (*Emblicaofficinalis* Gaertn.) under medium black soil. Progressive Horticulture. 2013;45(2):385-387.
8. Singh AK, Singh S, Rao VVA. Influence of organic and inorganic nutrient sources on soil properties and quality of Aonla in hot semi-arid ecosystem. Indian Journal of Horticulture. 2012;69(1):50-54.
9. Chundawat BS. Integrated nutrient management in tropical and subtropical

- fruits. Proc. National seminar on new horizon in production and post management of tropical and subtropical fruits. Research. 2001;21(4):499-503.
10. Roy RN, Ange AL. In: integrated plant nutrient systems (ipns) and sustainable agriculture. Proceedings fai annual seminar, fai, new delhi, sv. 1991;1-1:1-12.
  11. Lata R, Dwivedi DH, Ram RB, Meena ML, Babu M. Impact of integrated nutrient management on growth parameters of strawberry cv. Chandler under sub-tropical conditions of Lucknow. International Journal of Advanced Biological and Biomedical Research. 2013;3(3):418-421.
  12. Sneha Singh, Bhanu Pratap, Vimlesh Kumar, Govind Vishwakarma, Atul Yadav, Dheeraj Yadav and Abhinav Kumar. Assess the Effect of Integrated Nutrient Management on Vegetative Growth and Quality of Aonla cv. Francis. Int. J. Curr. Microbiol. App. Sci. 2021;10(02):3340-3351
  13. Singh AK, Singh S, Apparao VV, Hiwale SS, Joshi HK, Sharma SK. Effect of organic manure and biofertilizers on soil properties and growth of Aonla under rainfed condition of hot semi-arid environment. Indian Journal of Arid Horticulture. 2012;7(1-2):45–8.
  14. Singh AK, Singh S, Apparao VV. Influence of organic and inorganic sources of nutrients on soil properties and quality of Aonla under hot semi-arid ecosystem. Indian Journal of Horticulture. 2012;69(1): 50–4.
  15. Singh AK, Singh S, Hiwale SS, Apparao VV, Joshi HK. Production technology of Aonla under rainfed conditions of western India. *Technical Bulletin*, pub. Ches (icarciah). 2014;1–36.
  16. Singh AK, Singh S, Apparao VV, Hiwale SS, Joshi HK. Long-term effect of INM on Aonla and soil quality under rainfed hot semi-arid environment. Indian Journal of Agricultural Sciences. 2014;84(5):37–40.
  17. Katyal JC. Integrated nutrient management and supply: An overview. Proceeding of the Indian science academy part b. Biological Science. 1993;59(3-4):167-172.
  18. Gaurishankar, Verma LP, Singh Room. Effect of integrated nutrient management on yield and quality of Indian mustard (*Brassica. juncea*) and properties of soil. Indian Journal of Agricultural Sciences. 2002;72(9):551-552.

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