

Evaluate the effect of Integrated Nutrient Management (INM) on the Economic and Physical attributes of Aonla (*Emblica officinalis* Gaerten)

Abstract

The present investigation was conducted to Evaluate the effect of Integrated Nutrient Management on Economic and Physical attributes of Aonla (*Emblica officinalis* Gaerten). The research was carried at Main Experiment Station, Horticulture, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.) during the year 2021. It was laid out in a randomized block design with 10 treatments, namely: T₁ – Control, T₂- RDF 100% (1kg.N: 0.5kg.P:1kg.K per tree), T₃- FYM (10kg./tree) + RDF 100%, T₄- Poultry Manure (7.5kg./tree) + RDF 100%, T₅- FYM (10kg./tree) + RDF 50% + Azospirillum (10ml./tree), T₆- Poultry Manure (7.5kg/tree) + RDF 50% + Azospirillum(10ml./tree), T₇ -FYM (10kg./tree) + RDF 50% + PSB (10ml./tree), T₈- PoultryManure + RDF 50% + Azospirillum (10ml./tree), T₉ -FYM (10kg/tree) + RDF 50% + Azospirillum (10ml./tree) + PSB (10ml./tree) and T₁₀- Poultry Manure (7.5kg/tree) + RDF 50% + Azospirillum (10ml/tree) + PSB (10ml./tree).The experiment was replicated three times. Results showed treatment T₁₀ outperformed the rest with maximum fruit set percent (78.56%), fruit retention (20.29%), fruit yield (102.78 kg/tree), fruit weight (41.89 g), fruit length (3.87 cm), specific gravity (1.05 g/cm³) and maximum gross return/ha Rs. (128264), Net return Rs. (92154) and Cost: benefit ratio was evaluated with the use of treatment combination T₁₀. Thus, the treatment combination T₁₀ is therefore recommended for application to Aonla trees in eastern Uttar Pradesh in order to obtain high yields with better quality fruits.

Key word: INM, Aonla, Physical Quality, *Azospirillum*.

Introduction:

The Indian gooseberry, or aonla (*Emblica officinalis* Gaerten), belongs to the family “Euphorbiaceae” with the chromosome number 2n=28. It is native to Indo- China, particularly in central and southern India. Aonla finds mention in the ‘Vedas, Ramayana, Charak Samhita and other ancient Indian literature describing its fruit highly valuable as food, medicine, and hair dye. In India, Aonla cultivation is done mainly in northwest Himalayas (J & K, Himachal Pradesh, and Uttarakhand) to eastern Himalayas (Assam, Manipur, Meghalaya, Mizoram, and Tripura). The domestication of Aonla was first started in Varanasi, Uttar Pradesh, with the initiative of Maharaja Kashi. Banarasi, a superior genotype, was selected from the wild aonla trees available in large numbers in the nearby Vindhyan hills. Authentic information regarding its cultivation

dates back to 1881-82 in the Pratapgarh district of Uttar Pradesh. The ailing state owner of the district (King) was advised to regular consumption of aonla fruits (**Singh et al., 2019**).

It is commercially cultivated in Uttar Pradesh, Uttrakhand, Gujarat, Maharashtra, Rajasthan, Tamilnadu, Andhra Pradesh, Karnataka, Bihar, Haryana, Madhya Pradesh, and west Bengal. In Uttar Pradesh, Aonla is more cultivated in nearby the belt of Pratapgarh, which is followed by Ayodhya district. The area under the Aonla orchard in Pratapgarh district is about 1300 hectares. Whereas, the area in Sadler Block of the district of Pratapgarh is approximately 3250 hectares (**Rai et al., 2017**)

Aonla is a subtropical plant and prefers a dry subtropical climate, but it can be successfully cultivated in a wide range of soil and climatic conditions. Aonla is a medium sized, much-branched tree, occupying a height of 10-20 m. Inflorescence is racemose type, flower minute, unisexual, with a short pedicel. It is one of the richest sources of vitamin C (400-1300mg/100g. fruit pulp) among the fruits next to Barbados cherries. Its fruit also contains 82.2% water, 0.5% protein, 0.1% fat, 14% carbohydrate, calcium, phosphorous, and iron. Aonla has nutritional and medicinal value. Aonla is accepted as a hair tonic in traditional recipes for enriching hair growth and hair pigmentation. It is an important ingredient in Triphala and Chawanprash in the Ayurvedic Medicine System. Fruits are commonly used for the preparation of preserves (murabba), pickles, candy, jelly, etc. It can be dried and powdered to be used later. The soils of India, especially those of arid and semi-arid regions, are impoverished and hungry for plant nutrients. Considering economy, energy, and environment, it is imperative that nutrients are used effectively by adopting the appropriate doses of nutrients to be applied, their placement, and the correct timings to ensure higher yields and sustain the available nutrients in soil at the optimum level. Efficient nutrient management not only helps in increasing the present fruit and vegetable production level but also sustains fruit production and protects the environment from different types of hazards occurring due to misuse of costly fertilizers. Integrated nutrient management practices will help to increase the productivity of the crop and enrich the biota of the soil (**Sharma et al., 2018**). It involves a proper combination of chemical fertilizer, organic manures, and biofertilizers suitable to the system of land use and ecological, social, and economic conditions.

Method and Material:

The present investigation was carried out at the Main Experiment Station, Horticulture, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya

(U.P.) during the years 2021-2022. The experiment was laid out in randomized block design with 10 treatments,

namely: T₁ – Control, T₂- RDF 100% (1kg.N: 0.5kg.P:1kg.K per tree), T₃- FYM (10kg./tree) + RDF 100%, T₄- Poultry Manure (7.5kg./tree) + RDF 100%, T₅- FYM (10kg./tree) + RDF 50% + Azospirillum (10ml./tree), T₆- Poultry Manure (7.5kg/tree) + RDF 50% + Azospirillum (10ml./tree), T₇ -FYM (10kg./tree) + RDF 50% + PSB (10ml./tree), T₈- PoultryManure + RDF 50% + Azospirillum (10ml./tree), T₉ -FYM (10kg/tree) + RDF 50% + Azospirillum (10ml./tree) + PSB (10ml./tree) and T₁₀- Poultry Manure (7.5kg/tree) + RDF 50% + Azospirillum (10ml/tree) + PSB (10ml./tree). The experiment was replicated three times. The Ayodhya district's climate is classified as semi-arid, with three distinct seasons: rainy or wet, winter, and summer or hot. The rainy season begins the last week of June and lasts until September or even into October, with 1200 mm of rain on average. The soil was identified as sandy loam with an average pH of 7.71 and an average proportion of fine sand (64.77%), silt (22.76%), and clay (14.95%). Thirty-six year old plants were used in the experiment. The prescribed schedule for the Aonla plantation was followed for the usual cultural operations, plant protection measures, and basal application of manures and fertilizers. Data was collected on fruit set (%), fruit retention (%), fruit yield kg/plant), fruit weight (g/fruit), fruit size (cm), fruit volume and specific gravity, and cost-benefit ratio. The data obtained during experimentation were statistically analysed as per the method given by **Panse and Sukhatme (1985)**.

Result and Discussion:

Effect of INM on different physical attributes and economic of Aonla:-

Fruit Set (%):

The data significantly presented in Table 1 revealed that maximum fruit set percent (78.56%) was noticed with the use of treatment T₁₀ –Poultry Manure (7.5 kg/tree) + RDF 50% + Azospirillum (10 ml/tree) + PSB (10 ml/tree), followed by the use of T₉- FYM (10 kg/tree) + RDF 50% + Azospirillum (10 ml/tree) + PSB (10 ml/tree). However, the minimum fruit set value (55.71%) was recorded with the use of T₁- control, which was at par with T₅ -FYM (10 kg/tree) + RDF 50% + Azospirillum (10 ml/tree), T₆- Poultry Manure (7.5 kg/tree) + RDF 50% + Azospirillum (10 ml/tree), and T₇- FYM (10 kg/tree) + RDF 50% + PSB (10 ml/tree).

Fruit Retention (%):

It is apparent from Table1 treatment T₁₀-Poultry Manure (7.5kg/ tree) + RDF 50% + Azospirillum (10 ml/tree) + PSB (10 ml/tree) recorded significantly maximum number of fruit

retention was obtained (20.29%) followed with the use of T₉-FYM (10 kg/tree) + RDF 50% + *Azospirillum* (10 ml/tree) + PSB (10 ml/tree). Whereas, the minimum fruit retention (12.23%) percent was observed in treatment T₁ (control), which was statistically at par with T₂-RDF 100% (1kgN: 0.5kgP:1kgK per tree) and T₃- FYM (10 kg/tree) + RDF 100%. The results are consistent with the findings of **Hiwale (2009) and Prabhu et al. (2018)**.

Table: 1 Physical attributes of Aonla fruit

	Treatments	Fruit Set (%)	Fruit Retention (%)	Fruit Yield (kg/tree)	Fruit Weight (g)	Fruit Length (cm)	Fruit Width (cm)
T₁	Control	55.71	12.23	54.97	37.14	3.10	3.32
T₂	RDF 100 % (1kg N : 0.5kg P : 1kg K per tree)	57.53	13.98	68.15	38.90	3.18	3.45
T₃	FYM (10kg/tree) + RDF 100%	59.66	15.55	73.46	39.17	3.30	3.50
T₄	Poultry manure (7.5kg/tree) + RDF 100%	62.20	15.99	77.05	39.27	3.40	3.52
T₅	FYM (10kg/tree) + RDF50% + <i>Azospirillum</i> (10ml/tree)	66.10	16.80	82.15	39.98	3.42	3.57
T₆	Poultry manure (7.5kg/tree) + RDF 50% + <i>Azospirillum</i> (10ml/tree)	70.06	17.80	85.08	40.06	3.46	3.62
T₇	FYM (10kg/tree) + RDF 50% + PSB (10ml/tree)	73.16	18.0	90.02	40.87	3.60	3.70
T₈	Poultry manure + RDF 50% + PSB (10ml/tree)	74.73	18.90	93.13	41.24	3.65	3.90
T₉	FYM + RDF 50% + <i>Azospirillum</i> (10ml/tree) + PSB (10ml/ tree)	76.13	19.50	96.09	41.38	3.69	4.00
T₁₀	Poultry manure (7.5kg/tree) + RDF 50% + <i>Azospirillum</i> (10ml/	78.56	20.29	102.78	41.89	3.87	4.15

	tree) + PSB (10ml/tree)						
	SEm ±	0.77	0.36	1.27	0.68	.04	0.06
	CD at 5%	2.22	1.07	3.76	2.02	0.11	0.17

Table 1: Shows fruit set, fruit retention, fruit yield, fruit weight, fruit length and fruit width in Aonla fruit

Fruit Yield (kg/tree):

Data presented in Table 1 clearly indicated that application of Poultry Manure (10kg/tree) + RDF 50% + *Azospirillum* (10ml./tree) + PSB (10ml./tree) was found to be significantly the best treatment, with a maximum fruit yield obtained of 129.79 kg per tree, followed by FYM (10kg/tree) + RDF 50% + *Azospirillum* (10ml./tree) + PSB (10ml./tree). Whereas, the minimum fruit yield obtained was 72.95 kg per tree in treatment (control). The present findings are in conformity with the report of **Amiri and Fallahi (2009)**, **Bhabiskar et al. (2011)**, **Aiyelaagbe et al. (2012)** and **Ghosh et al. (2012)**.

Fruit Weight (g):

The significantly maximum fruit weight (41.89 g) was recorded in the treatment T₁₀- Poultry Manure (7.5kg/ tree) + RDF 50% + *Azospirillum* (10ml. /tree) + PSB (10ml. /tree) followed by treatment T₉- FYM (10kg/tree) + RDF 50% + *Azospirillum* (10ml. /tree) + PSB (10ml./tree). Whereas, treatment T₁ which is the control, indicated the minimum

average fruit weight (37.14 g), and application of T₈, T₇ and T₆ were found to be on par with T₁₀ and proved equally good at increasing fruit weight. This type of result is in close conformity with (1125:750:375 g NPK + 15 kg vermicompost + 250 g *Azotobactor* + 250 g PSB/plant) in Sapota **Bhabiskar et al. (2011)**, **Manjunath et al., (2006)** **Bendegumbal et al., (2008)** and also reported by **Aal et al. (2020)**.

Fruit Length (cm):

Fruit length, as clearly presented in Table 1, revealed that the response of Poultry Manure (7.5kg/ tree) + RDF 50% + *Azospirillum* (10ml. /tree) + PSB (10ml. /tree). The significantly higher fruit length was recorded with treatment T₁₀ Poultry Manure (7.5kg/ tree) + RDF 50% + *Azospirillum* (10ml./tree) + PSB (10ml./tree) and value was obtained (3.87cm) followed by T₉- FYM (10kg/tree) + RDF 50% + *Azospirillum* (10ml./tree) + PSB (10ml./tree) which was on par with T₈ and T₇. However, the minimum fruit length (3.10cm) observed with treatment T₁

i.e., control. Bhabiskar et al. (2011) reported maximum fruit size treated with (1125:750:375 g NPK + 15 kg vermicompost + 250 g *Azotobactor* + 250 g PSB/plant).

Fruit Width (cm):

It is evident from the data presented in Table 1 that the application of integrated nutrient management significantly influenced the fruit width, with the T₁₀ treatment recording the maximum fruit width value obtained (4.15 cm), followed by T₁₀. However, treatment T₁₀ indicated a minimum fruit width value of 3.32 cm, which was statistically on par with T₂ and T₃. Bhabiskar et al. (2011) reported maximum fruit size treated with (1125:750:375 g NPK + 15 kg vermicompost + 250 g *Azotobactor* + 250 g PSB/plant) and a similar result was also reported by Aal et al. (2020) with the application of 50% RDF through chemical fertilizer + 25% RDN through vermicompost + 10 ml. Anubhav bio NPK conservation/tree).

Specific gravity (g/cm³):

The maximum specific gravity value (1.05g /cm³) was recorded with the use of T₁₀ followed by T₉. However, T₁₀ was on par with treatments T₈, T₇, T₃ and T₂ whereas the minimum specific gravity value (1.01g/cm³) was recorded with treatment T₁, which is the control. This type of finding conformity with Rayees et al. (2015) revealed that application of various treatment combinations of organic and inorganic fertilizers in strawberry (*Fragaria x annanassa* Duch.) was observed to have maximum specific gravity.

Economics attributes:

Cost of production:

Data pertaining to Table 2 show that the cost of production varied as a result of variations in different treatments. Maximum total cost of production was noted with the use of T₁₀ Poultry Manure (7.5kg/tree) + RDF 50% + *Azospirillum* (10ml/tree) + PSB (10ml./tree) followed by application of T₉ FYM (10kg/tree) + RDF 50% + *Azospirillum* (10ml./tree) + PSB (10ml./tree).

Gross return:

The highest gross return/hectare (Rs. 128264) was recorded with the use of T₁₀. The lowest gross return/hectare is Rs. 68584 with the application of T₁.

Net return:

Data pertaining to Table 2 revealed that the maximum net returns obtained with the application of T₁₀ Poultry Manure (7.5kg/tree) + RDF 50% + *Azospirillum* (10ml/tree) + PSB (10ml. /tree).

Cost: benefit ratio:

Data pertaining to Table 2 revealed that the maximum benefit ratio was obtained with the application of T₁₀ Poultry Manure (7.5kg/tree) + RDF 50% + *Azospirillum* (10ml/tree) + PSB (10ml. /tree). These types of results were noted by Kumar et al. (2018) in strawberry with the combined application of organic manures and also reported by **Srivastava et al. (2014)**.

Table: 2 Economics of different INM during present investigation:

	Treatments	Yield (q/ha.)	Cost of production (Rs. /ha.)	Gross income (Rs./ha.)	Net income (Rs./ha.)	Cost: benefit ratio
T₁	Control	99.74	26650	68584	41394	1:1.57
T₂	RDF 100 % (1kg N : 0.5kg P : 1kg K per tree)	106.31	30753	85048	54295	1:1.76
T₃	FYM (10kg/tree) + RDF 100%	114.59	31450	97672	60222	1:1.91
T₄	Poultry manure (7.5kg/tree) + RDF 100%	120.19	32120	96152	64032	1:1.99
T₅	FYM (10kg/tree) + RDF50% + <i>Azospirillum</i> (10ml/tree)	128.54	32990	102832	69842	1:2.11
T₆	Poultry manure (7.5kg/tree) + RDF 50% + <i>Azospirillum</i> (10ml/ tree)	132.74	33210	106176	72966	1:2.19
T₇	FYM (10kg/tree) + RDF 50% + PSB (10ml/tree)	140.43	34340	112344	78004	1:2.27
T₈	Poultry manure + RDF 50% + PSB (10ml/tree)	145.28	34995	116224	81229	1:2.32
T₉	FYM + RDF 50% + <i>Azospirillum</i>	149.90	35650	119920	84270	1:2.36

	(10ml/tree) + PSB (10ml/ tree)					
T₁₀	Poultry manure (7.5kg/tree) + RDF 50% + <i>Azospirillum</i> (10ml/tree) + PSB (10ml/tree)	160.33	36110	128264	92154	1:2.55

Conclusion:

In this way, it was revealed that the maximum physical and economical attributes, viz., fruit set % , fruit retention (%), fruit yield (kg/tree), fruit weight (g), fruit width (cm), and cost-benefit ratio were obtained with the application of poultry manure (7.5kg/tree) + RDF 50% + *Azospirillum* (10ml/ tree) + PSB (10ml/tree).

Future Scope:

INM is a system that helps to restore and sustain crop productivity and also assists in checking emerging micronutrient deficiencies. With this view, there is a dire need to minimize the use of chemical fertilizers with the use of integrated nutrient management for better growth and yield of fruits.

References

- Anonymous. 1964.** Agriculture in ancient India.
- Aal, J.M.; Patel, K. M.; Patel, S.J.; and Sindha, D. J. 2020.** Effect of integrated nutrient management on fruit yield of aonla (*Emblica officinalis* Gaertn) cv. Gujarat Aonla-1, *International Journal of Current Microbiology and Applied Sciences* 9(10): 417-423.
- Amiri, M.E. and Fallahi, E. 2009.** Impact of animal manure on soil chemistry mineral nutrients, yield and fruit quality in Golden Delicious apple. *Journal. Plant Nurture*, 32: 610-617
- Aiyelaagbe, I. O. O., Oshuniyi, A. A. and Adegoke, J. O. 2012.**Response of Smooth Cayenne pineapple to organic fertilizer in south western Nigeria. In: Proceedings of XXVIIIth IHC-International Symposium on Organic Horticulture: Productivity and Sustainability. *Acta Horticulture*, 933: 261- 264.
- Bhabiskar MN; Bharad SG; DOD VN, Barne VG. 2011.** Effect of integrated nutrient management on yield and quality of sapota. *Plant Archives*. 11(2):661- 663.
- Bendegumbal, S.; Sajjan, Ashok, S.; Vyakaranahal, B.S.; Malbasari, T.A.; Hosamani, R.M. and Patil, A.B. (2008).**Studies of organic seed production in onion. *Karnataka J. Agric. Sci.*, 21(1): 120-121.

- Chopra, R.N.; I.C. Chopra; Handa and L.D. Kapur 1958.**Chopra's indigenous drugs of India (2nd Ed.) U.N. Dhur and Sons Pvt., Calcutta.
- Ghosh, S. N.; Bera, B.; Roy, S. and Kundu, A. (2012).**Integrated nutrient management in pomegranate grown in laterite soil. *Indian J. of Hort.*; 69(3):333-337.
- Hiwale, SS 2009.**The pomegranate. New Delhi, New India Publishing Agency. 2009, 158.
- Manjunath, H.; Ganigar, V. M.; Reddy, B.G. and Joshi, V.R. (2006).**Integrated nutrient management in sapota (*Achorussapota*) using vermicompost to increase yield and quality. *Indian J. Agric. Sci.*, 76(10): 587-590.
- Panse, V.C. and Sukhatme, P.V. 1985.** Statistical Methods for Agricultural Workers, ICAR, New Delhi.
- Prabhu, M., Parthiban, S., Kumar, A.R., Rani, B.U. and Vijayasamundeeswari. 2018.** Effect of integrated nutrient management on acid lime (*Citrus aurantifolia* Swingle. (L.)). *Indian Journal of Agricultural Research*, 52(3): 290-294.
- Rayees A. Wani, S A Hakeem, Sabiya Bashir, Seerat Geelani, Mohammad Najeeb Mughal, V.M. Prasad, 2015.**Impact of integrated nutrient management on growth, yield and quality of strawberry (*Fragaria x annanassa* Duch.) cultivation in India. *Nat Sci.*13 (1):39-44]. (ISSN: 1545-0740).
- Sharma, B.D., Meena Anita, Jatav, M.K. and Balai, Roop Chand, 2018.**Integrated nutrient management for horticultural crops in arid region. CIAH/ Tech./ Pub. No.77, pp 42. ICAR-Central Institute for Arid Horticulture, Bikaner, Rajasthan, India.
- Srivastava, Amrish, Singh, J.K. and Singh, H.K. 2014.**Integrated Nutrient Management (INM) on growth, yield and quality of papaya (*Carica papaya* L.) cv. CO-7. *Asian J. Hort.*, 9(2): 390-395.