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

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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 present investigation was conducted to Evaluate the effect of Integrated Nutrient Management (INM) on the Economic and Physical attributes of Aonla (Emblica officinalis Gaerten). The research was carried at Main Experiment Station, Horticulture, Acharya Narendra Deva University of

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Agriculture and Technology, Kumarganj, Ayodhya (U.P.) during the year 2021. It was laid out in a randomized block design with 10 treatments, namely: T_1 – Control, T_2- RDF 100% (1kg.N: 0.5kg.P:1kg.K per tree), T_3- FYM (10kg./tree) + RDF 100%, T_4- Poultry Manure (7.5kg./tree) + RDF 100%, T_5- FYM (10kg./tree) + RDF 50% + *Azospirillium* (10ml./tree), T_6- Poultry Manure (7.5kg/tree) + RDF 50% + *Azospirillium* (10ml./tree), T_7 -FYM (10kg./tree) + RDF 50% + PSB (10ml./tree), T_8- Poultry Manure + RDF 50% + *Azospirillium* (10ml./tree), T_9 –FYM (10kg/tree) + RDF 50% + *Azospirillium* (10ml./tree) + PSB (10ml./tree) and T_{10}- Poultry Manure (7.5kg/tree) + RDF 50% + *Azospirillium* (10ml/tree) + PSB (10ml./tree).The experiment was replicated three times. Results showed treatment T_{10} 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 T_{10}. Thus, the treatment combination T_{10} is therefore recommended for application to Aonla trees in eastern Uttar Pradesh in order to obtain high yields with better quality fruits.

Keywords: INM; aonla; physical quality; Azospirillium.

1. 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 Uttrakhand) 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 fallowed by Ayodhya district. The area under the Aonla orchard in Pratapgarh district is about 1300 hectares. Whereas, the area in Sadder 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 (400-1300 mg/100 g. 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 [1]. 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.

2. MATERIALS AND METHODS

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: T_1 – Control, T_2- RDF 100% (1kg.N: 0.5kg.P:1kg.K per tree), T_3- FYM (10kg./tree) + RDF 100%, T_4- Poultry Manure (7.5kg./tree) + RDF 100%, T_5- FYM (10kg./tree) + RDF 50% + *Azospirillium* (10ml./tree), T_6- Poultry Manure (7.5kg/tree) + RDF 50% + *Azospirillium* (10ml./tree), T_7 -FYM (10kg./tree) + RDF 50% + PSB (10ml./tree), T_8- Poultry Manure + RDF 50% + *Azospirillium* (10ml./tree), T_9 –FYM (10kg/tree) + RDF 50% + *Azospirillium* (10ml./tree) + PSB (10ml./tree) and T_{10}- Poultry Manure (7.5kg/tree) + RDF 50% + *Azospirillium* (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 [2].

3. RESULTS AND DISCUSSION

3.1 Effect of INM on Different Physical Attributes and Economic of Aonla

3.1.1 Fruit set (%)

The data significantly presented in Table 1 revealed that maximum fruit set percent (78.56%) was noticed with the use of treatment T_{10} –Poultry Manure (7.5 kg/tree) + RDF 50% + *Azospirillum* (10 ml/tree) + PSB (10 ml/tree), followed by the use of T_9- 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 T_1- control, which was at par with T_5 -FYM (10 kg/tree) + RDF 50% + *Azospirillum* (10 ml/tree), T_6- Poultry Manure (7.5 kg/tree) + RDF 50% + *Azospirillum* (10 ml/tree), and T_7- FYM (10 kg/tree) + RDF 50% + PSB (10 ml/tree).

3.1.2 Fruit retention (%)

It is apparent from Table 1 treatment T_{10}-Poultry Manure (7.5kg/ tree) + RDF 50% + *Azospirillium* (10 ml/tree) + PSB (10 ml/tree) recorded significantly maximum number of fruit retention was obtained (20.29%) fallowed with the use of T_9-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 T_3- FYM (10 kg/tree) + RDF 100%. The results are consistent with the findings of Hiwale [3] and Prabhu et al. [4].

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

3.1.3 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 was72.95 kg per tree in treatment (control). The present findings are in conformity with the report of Amiri and Fallahi [5] Bhabiskar et al. [6] Aiyelaagbe et al. [7] and Ghosh et al. [8].

3.1.4 Fruit weight (g)

The significantly maximum fruit weight (41.89 g) was recorded in the treatment T_{10}- Poultry Manure (7.5kg/ tree) + RDF 50% + *Azospirillum* (10ml. /tree) + PSB (10ml. /tree) fallowed by treatment T9- FYM (10kg/tree) + RDF 50% + *Azospirillum* (10ml. /tree) +PSB (10ml./tree). Whereas, treatment T_1 which is the control, indicated the minimum average fruit weight (37.14 g), and application of T_8, T_7 and T_6 were found to be on par with T_{10} and proved equally good at increasing fruit weight. This type of result

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)
T_1	Control	55.71	12.23	54.97	37.14	3.10	3.32
T_2	RDF 100 % (1kg N : 0.5kg P : 1kg K per tree)	57.53	13.98	68.15	38.90	3.18	3.45
T_3	FYM (10kg/tree) + RDF 100%	59.66	15.55	73.46	39.17	3.30	3.50
T_4	Poultry manure (7.5kg/tree) + RDF 100%	62.20	15.99	77.05	39.27	3.40	3.52
T_5	FYM (10kg/tree) + RDF50% + *Azospirillium* (10ml/tree)	66.10	16.80	82.15	39.98	3.42	3.57
T_6	Poultry manure (7.5kg/tree) + RDF 50% + *Azospirillium* (10ml/ tree)	70.06	17.80	85.08	40.06	3.46	3.62
T_7	FYM (10kg/tree) + RDF 50% + PSB (10ml/tree)	73.16	18.0	90.02	40.87	3.60	3.70
T_8	Poultry manure + RDF 50% + PSB (10ml/tree)	74.73	18.90	93.13	41.24	3.65	3.90
T_9	FYM + RDF 50% + *Azospirillium* (10ml/tree) + PSB (10ml/ tree)	76.13	19.50	96.09	41.38	3.69	4.00
T_{10}	Poultry manure (7.5kg/tree) + RDF 50% + *Azospirillum* (10ml/ tree) + PSB (10ml/tree)	78.56	20.29	102.78	41.89	3.87	4.15
	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 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
T_1	Control	99.74	26650	68584	41394	1:1.57
T_2	RDF 100 % (1kg N : 0.5kg P : 1kg K per tree)	106.31	30753	85048	54295	1:1.76
T_3	FYM (10kg/tree) + RDF 100%	114.59	31450	97672	60222	1:1.91
T_4	Poultry manure (7.5kg/tree) + RDF 100%	120.19	32120	96152	64032	1:1.99
T_5	FYM (10kg/tree) + RDF50% + *Azospirillium* (10ml/tree)	128.54	32990	102832	69842	1:2.11
T_6	Poultry manure (7.5kg/tree) + RDF 50% + *Azospirillium* (10ml/ tree)	132.74	33210	106176	72966	1:2.19
T_7	FYM (10kg/tree) + RDF 50% + PSB (10ml/tree)	140.43	34340	112344	78004	1:2.27
T_8	Poultry manure + RDF 50% + PSB (10ml/tree)	145.28	34995	116224	81229	1:2.32
T_9	FYM + RDF 50% + *Azospirillium* (10ml/tree) + PSB (10ml/ tree)	149.90	35650	119920	84270	1:2.36
T_{10}	Poultry manure (7.5kg/tree) + RDF 50% + *Azospirillum* (10ml/ tree) + PSB (10ml/tree)	160.33	36110	128264	92154	1:2.55

is in close conformity with (1125:750:375 g NPK + 15 kg vermicompost + 250 g *Azotobactor* + 250 g PSB/plant) in Sapota [6,9,10] and also reported by Aal et al. [11].

3.1.5 Fruit length (cm)

Fruit length, as clearly presented in Table 1, revealed that the response of Poultry Manure (7.5kg/ tree) + RDF 50% + *Azospirillium* (10ml. /tree) + PSB (10ml. /tree). The significantly higher fruit length was recorded with treatment T_{10} Poultry Manure (7.5kg/ tree) + RDF 50% + *Azospirillium* (10ml./tree) + PSB (10ml./tree) and value was obtained (3.87cm) fallowed by T_9- - FYM (10kg/tree) + RDF 50% + *Azospirillium* (10ml./tree) +PSB (10ml./tree) which was on par with T8 and T_7. However, the minimum fruit length (3.10cm) observed with treatment T_1 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).

3.1.6 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 T_{10} treatment recording the maximum fruit width value obtained (4.15 cm), followed by T_{10}. However, treatment T_{10} indicated a minimum fruit width value of 3.32 cm, which was statistically on par withT_2 and T_3. Bhabiskar et al. [6] 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).

3.1.7 Specific gravity (g/cm3)

The maximum specific gravity value (1.05g /cm3) was recorded with the use of T_{10} followed by T_9. However, T_{10} was on par with treatments T_8, T_7, T_3 and T_2 whereas the minimum specific gravity value (1.01g/cm3) was recorded with treatment T_1, which is the control. This type of finding conformity with Rayees et al. [12] 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.

3.2 Economics Attributes

3.2.1 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 T_{10} Poultry Manure (7.5kg/tree) + RDF 50% + *Azospirillium* (10ml/tree) + PSB (10ml./tree) followed by application of T_9 FYM (10kg/tree) + RDF 50% + *Azospirillium* (10ml./tree) + PSB (10ml./tree).

3.2.2 Gross return

The highest gross return/hectare (Rs. 128264) was recorded with the use of T_{10}. The lowest gross return/hectare is Rs. 68584 with the application of T_1.

3.2.3 Net return

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

3.2.4 Cost: benefit ratio

Data pertaining to Table 2 revealed that the maximum benefit ratio was obtained with the application of T_{10} Poultry Manure (7.5kg/tree) + RDF 50% + *Azospirillium* (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. [13,14,15].

4. 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 (7.5 kg/tree) + RDF 50% + *Azospirillum* (10 ml/ tree) + PSB (10 ml/tree).

5. 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.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Sharma BD, Meena Anita, Jatav MK, Balai, Roop Chand, 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; 2018.
2. Panse VC, Sukhatme PV. Statistical Methods for Agricultural Workers, ICAR, New Delhi; 1985.
3. Hiwale SS. The pomegranate. New Delhi, New India Publishing Agency. 2009;158.
4. Prabhu M, Parthiban S, Kumar AR, Rani BU, Vijayasamundeeswari. Effect of integrated nutrient management on acid lime (*Citrus aurantifolia* Swingle. (L.)]. Indian Journal of Agricultural Research. 2018.52(3):290-294.
5. Amiri ME, Fallahi E. Impact of animal manure on soil chemistry mineral nutrients, yield and fruit quality in Golden Delicious apple. Journal. Plant Nurture. 2009;32:610-617.
6. Bhabiskar MN, Bharad SG, DOD VN, Barne VG. Effect of integrated nutrient management on yield and quality of sapota. Plant Archives. 2011;11(2):661-663.
7. Aiyelaagbe IOO, Oshuniyi AA, Adegoke JO. 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. 2012; 933:261-264.
8. Ghosh SN, Bera B, Roy S, Kundu A. Integrated nutrient management in pomegranate grown in laterite soil. Indian J. of Hort. 2012;69(3):333-337.
9. Manjunath H, Ganigar VM, Reddy BG, Joshi VR. Integrated nutrient management in sapota (*Achorussapota*) using vermicompost to increase yield and quality. Indian J. Agric. Sci. 2006;76(10):587-590.
10. Bendegumbal S, Sajjan, Ashok S, Vyakaranahal BS, Malbasari TA, Hosamani RM, Patil, AB. Studies of organic seed production in onion. Karnataka J. Agric. Sci. 2008;21(1):120-121.
11. Aal JM, Patel KM, Patel SJ, Sindha DJ. 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. 2020;9(10):417-423.
12. Rayees A, Wani SA, Hakeem, Sabiya Bashir, Seerat Geelani, Mohammad Najeeb Mughal, VM, Prasad, Impact of integrated nutrient management on growth, yield and quality of strawberry (*Fragaria x annanassa* Duch.) cultivation in India. Nat Sci. 2015;13(1):39-44]. (ISSN: 1545-0740).
13. Srivastava, Amrish, Singh JK, Singh HK. Integrated Nutrient Management (INM) on growth, yield and quality of papaya (*Carica papaya* L.) cv. CO-7. *Asian J. Hort.* 2014;9(2):390-395.
14. Anonymous. Agriculture in ancient India; 1964.
15. Chopra RN, Chopra IC, Handa, Kapur LD. Chopra's indigenous drugs of India (2nd Ed.) U.N. Dhur and Sons Pvt., Calcutta; 1958.

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