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Impact of Nutrient Management through Bio-organic Manure on Bio-chemical Attributes of Aonla (*Emblica Officinalis* Gaertn.) cv. NA-10

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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 influence of nutrient management using bio-organic manure on bio-chemicals in Aonla. 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: 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 thrice. Results showed treatment T_{10}- Poultry Manure (7.5kg/tree) + RDF 50% + Azospirillium (10ml/tree) + PSB (10ml./tree) outperformed the rest with maximum TSS (11.83^0 Brix), Ascorbic acid content (599.98 mg/ 100g fruit pulp), reducing sugar (3.28%), non-reducing sugar (3.00%), total sugar (6.29%) and minimum acidity (1.32%). The treatment combination is therefore recommended for application to Aonla trees in Eastern Uttar Pradesh in order to obtain high yields with better quality fruits.

Keywords: Aonla; azospirillium; PSB; FYM; RDF; sugar; nutrient management; poultry manure.

1. INTRODUCTION

The Indian gooseberry or aonla (*Emblica officinalis* Gaerten) belongs to family “Euphorbiaceae” with the chromosome number 2n=28. Aonla also is known in different names in different region like Amla, Amolphal, Amalakamu, Dhatri, Nelli, Usirika and Maryobalan [1,2]. It is native to Indo- China, particularly in central and southern India. In India Aonla cultivation is done mainly in northwest Himalayas to eastern Himalaya. The domestication of Aonla was first started in Varanasi, Uttar Pradesh with the initiative of Maharaja of Kashi. Banarasi, a superior genotype was selected from the wild Aonla trees are available in large number in the nearby Vindhyan hills. Authentic information regarding its cultivation dates back to 1881-82 in the Pratapgarh district of Uttar Pradesh [3]. It occupies an area of 100 thousand hectares with a production of 1206 thousand MT [4].

In Uttar Pradesh, Aonla was more cultivated in nearby belt of Pratapgarh fallowed by Ayodhya district. Area under Aonla orchard in Pratapgarh district is about 1300 hectares. Whereas, the area in Sadder block of district of Pratapgarh is approximately 3250 hectares [5]. Aonla is a subtropical plant and prefers dry subtropical climate but it can be successfully cultivated in wide range of soils and climatic conditions. Owing to its hardy nature, suitability to various wastelands, high productivity, nutritive and therapeutic value Aonla has become an important fruit. Aonla is a medium sized, much-branched tree occupying height of 10-20 m. Inflorescence is racemose type, flower minute, unisexual with short pedicel. Fruit depressed round, globuse or oblate, indened at the base. It is richest sources of vitamin C (400-1300mg./100g fruit pulp) among the fruits next to Barbados cherry [6]. Sustained nutrient management is the passport to enter into the 21st century. In view of these situations, the application of nutrients from the combinations of inorganic, organic and biological sources not only fulfills the nutrient requirement of the crop but also improve the soil health. Hence integrated nutrient management practices will help to increase the productivity of the crop and enrich the soil [7]. Organic manures supply plant nutrients and micronutrients. They improve soil physical properties like soil structure, infiltration, porosity, water holding capacity, bulk density etc. Organic manures act as buffering agents and supplies food for beneficial living organism [8]. The present investigation will be undertaken to generate the sufficient information with the following objectives. 1. To find out the effect of INM on physical attributes of aonla fruits, 2. To assess the effect of INM on chemical attributes of aonla fruits and 3. To work out the economic feasibility of the various treatment.

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.) during the year 2021-2022. Geographically the experimental site lies between the course of Gomati and Saryu rivers (Genetics alluvium). The site is situated 42 km away from the Ayodhya district headquarter and lies between a latitude of 81.12° and 83.89° at an elevation of 113.0 m above mean sea level. The experiment was laid out in Randomized Block Design with 10 treatments namely: $\mathbf{T_1}$ Control,$\mathbf{T_2}$ RDF 100% (1kg.N: 0.5kg.P:1kg.K per tree), $\mathbf{T_3}$ FYM (10kg./tree) + RDF 100%, $\mathbf{T_4}$ Poultry Manure (7.5kg./tree) + RDF 100%, $\mathbf{T_5}$ FYM (10kg./tree) + RDF50% + *Azospirillium* (10ml./tree), $\mathbf{T_6}$ Poultry Manure (7.5kg/tree) + RDF 50% + *Azospirillium* (10ml./tree), $\mathbf{T_7}$ FYM (10kg./tree) + RDF 50% + PSB (10ml./tree),$\mathbf{T_8}$ Poultry Manure (7.5kg/tree) + RDF 50% + PSB (10ml./tree), $\mathbf{T_9}$ FYM (10kg/tree) + RDF 50% + *Azospirillium* (10ml./tree) + PSB (10ml./tree), and $\mathbf{T_{10}}$ Poultry Manure (7.5kg/tree) + RDF 50% + *Azospirillium* + (10ml/tree) + PSB (10ml./tree) replicated thrice. 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 a 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 collect on Total Soluble Solids, ascorbic acid, acidity, reducing sugar, non-reducing sugar and total sugar including numerous other fruit characteristics. TSS was calculated using a hand refractometer and displayed in ^{0}Brix. By using the standard procedure outlined in AOAC [9], several chemical parameters including total sugars, ascorbic acid, and acidity were measured. The data obtained during experimentation were statistically analyzed as per the method given by Panse and Sukhatme [10].

3. RESULTS AND DISCUSSION

3.1 Total Soluble Solid (^{0}brix)

Results (Table 1) showed significant difference on total soluble solids of fruits influenced by various treatments. Treatment T_{10}- Poultry Manure (7.5kg/tree) + RDF 50% + *Azospirillium* (10ml/tree) +PSB (10ml/tree) recorded maximum total soluble solids value (11.82^{0}Brix) followed by T_9- FYM (10kg/tree) + RDF 50% + *Azospirillium* (10ml/tree) +PSB (10ml/tree). The lowest total soluble solid (8.82 ^{0}brix) was observed in the control treatment. It is assumed that TSS content increased with *Azospirillum* and FYM application which contributed to the quick metabolic transformation of starch and pectin into soluble compounds and rapid translocation of sugars from leaves to the developing fruits leading to conversion of complex polysaccharides into simple sugars with reference to Kumar et al. [11] who reported that application of 100% recommended dose of fertilizers (RDF) along with vermicompost + poultry manure + *Azospirillum* + PSB recorded maximum fruit TSS. The findings are also in conformity with Babiskar et al. [12], Sharma et al. [13] in kiwifruit and Jaiswal et al. [14] in guava.

3.2 Ascorbic Acid (mg./100g fruit pulp) and Acidity (%)

The highest ascorbic acid value 599.98 in Table 1 was recorded in treatment T_{10} Poultry Manure (7kg/tree) + RDF 50% + *Azospirillium* (10ml/tree) + PSB (10ml/tree), followed by treatment T_9- FYM (10kg/tree) + RDF 50% + *Azospirillium* (10ml/tree) +PSB (10ml/tree). However the lowest ascorbic acid 488.16 was observed in the control treatment The results indicated that the application of FYM, *Azospirillium* and PSB had significant influence on the content of ascorbic acid in the fruit. These results are in conformity with the findings of Yadav et al. [15], Bohane et al. [16], Kour et al. [17], Sharma et al. [13]. Treatments T_{10}- Poultry Manure (7.5 kg/tree) + RDF 50% + *Azospirillium* (10ml/tree) + PSB (10ml/tree) and T_9 FYM (10kg/tree) + RDF 50% + *Azospirillium* (10ml/tree) reduced acidity percent and obtained minimum fruit acidity value (01.32%) followed by treatment T_9. The decrease in acidity of fruits may be attributed to their conversion into sugars. Similar findings were also reported by Bohane et al. [16], Jamra et al. [18], Athani [19], Yadav et al. [15], Sharma et al. [13] and Jaiswal et al. [14] in guava.

3.3 Reducing and Non-reducing Sugar (%)

Results (Table 1) have shown significant maximum reducing sugar (3.28 %) with application of Poultry Manure (7.5 kg./tree) + RDF 50% + *Azospirillium* (10ml./tree) +PSB (10ml./tree) followed by FYM (10kg/tree) + RDF 50% + *Azospirillium* (10ml./tree). However minimum reducing sugar (2.10%) was recorded

Table 1. Shows TSS, ascorbic acid, acids, reducing and non sugars and total sugars in Aonla fruit

No.	Treatments	TSS (^{0}Brix)	Ascorbic acid (mg/100g fruit pulp)	Acidity (%)	Reducing sugar (%)	Non- reducing sugar (%)	Total sugars (%)
T_1	Control	8.82	488.16	2.01	2.10	1.9	4.00
T_2	RDF 100 % (1kg N : 0.5kg P : 1kg K per tree)	9.40	499.58	1.97	2.39	2.17	4.57
T_3	FYM (10kg/tree) + RDF 100%	9.48	509.51	1.85	2.65	2.25	4.91
T_4	Poultry manure (7.5kg/tree) + RDF 100%	9.54	512.16	1.79	2.76	2.30	5.06
T_5	FYM (10kg/tree) + RDF50% + *Azospirillium* (10ml/tree)	9.69	529.50	1.73	2.88	2.39	5.27
T_6	Poultry manure (7.5kg/tree) + RDF 50% + *Azospirillium* (10ml/ tree)	10.25	536.90	1.66	2.92	2.52	5.45
T_7	FYM (10kg/tree) + RDF 50% + PSB (10ml/tree)	10.50	555.37	1.55	3.10	2.62	5.72
T_8	Poultry manure + RDF 50% + PSB (10ml/tree)	10.58	569.63	1.49	3.16	2.88	6.04
T_9	FYM + RDF 50% + *Azospirillium* (10ml/tree) + PSB (10ml/ tree)	10.66	596.01	1.40	3.25	2.92	6.18
T_{10}	Poultry manure (7.5kg/tree) + RDF 50% + *Azospirillum* (10ml/ tree) + PSB (10ml/tree)	11.83	599.98	1.32	3.28	3.00	6.29
	SEm ±	0.47	1.35	**0.01**	0.03	0.04	0.05
	CD at 5%	1.41	4.02	**0.04**	0.08	0.12	0.14

in control treatment T_1. An increase in reducing sugars contents with *Azospirillum* and Farm Yard Manure application could be attributed to the quick metabolic transformation of starch and pectin into soluble compounds and rapid translocation of sugars from leaves to the developing fruits as well as the conversion of complex polysaccharides into simple sugars. Similar results were noted by Jamra et al. [18], Kour et al. [17] in Aonla, Verma et al. [20] in phalsa, Rai et al. [21] in Pear and Chawla et al. [22]. The application of Poultry Manure (7.5 kg/tree) + RDF 50% *Azospirillium* + (10ml/tree) +PSB (10ml/tree) (Table 1) showed significant maximum non- reducing sugars (3.0%) followed by FYM (10kg/tree) + RDF 50% + *Azospirillium* (10ml/tree) PSB (10ml/tree). While, minimum non-reducing sugar (1.9%) was observed in the control treatment T_1. The same reason could be applied that the quick metabolic transformation of starch and pectin into soluble compounds and rapid translocation of sugars from leaves to the developing fruits. The high non-reducing sugar (2.52%) were also recorded with application of Poultry Manure (7.5 kg/tree) + RDF 50% + *Azospirillium* (10ml/tree) + PSB (10ml/tree). The research findings were supported by Verma et al [20] in Phalsa, Chawla et al. [22], Jamra et al. [18] and Kour et al. [17] in Aonla.

3.4 Total Sugar (%)

In Table 1 the highest total sugars value (6.29%) were recorded in T_{10} treatment that is Poultry Manure (7.5 kg/tree) + RDF 50% + *Azospirillium* (10ml/tree) +PSB (10ml/tree) followed by T_9 treatment FYM (10kg/tree) + RDF 50% + *Azospirillium* (10ml/tree) and T_8 were proved equally good with $T_{10.}$ However minimum total sugar percent (4.00%) was recorded in control treatment T_1. The findings are corroborating with those reported by Singh et al. [23], Sharma et al. [13], Kour et al. [17] in aonla fruits, Verma et al. [20] and Yadav et al. [24] in Phalsa.

4. CONCLUSION

Based on the results of this present investigation, it can be concluded that treatment T_{10} (Poultry Manure (7.5kg/ tree) + RDF 50% + *Azospirillium* (10ml/tree) + PSB (10ml/tree) produced the maximum TSS (11.83^0 Brix), Ascorbic acid content (599.98 mg/ 100g fruit pulp), reducing sugar (3.28%), non-reducing sugar (3.00%), total sugar (6.29%) and minimum acidity (1.32%) of aonla which was at par with T_9-FYM (10kg/tree) + RDF 50% + *Azospirillium* (10ml./tree) + PSB (10ml./tree) can be recommended to aonla growers in eastern Uttar Pradesh for obtaining higher yield with better quality fruits.

5. FUTURE SCOPE

Integrated nutrient management, developed on the principles of eco-friendly and efficient balanced fertilizer and based in optimization of nutrient supplies from all the available sources, inorganic and organic, which lowers production costs and increases productivity, were the greatest ways to cultivate Aonla.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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