Impact of nutrient management through bio-organic manure on bio-chemical attributes of Aonla (*Emblica Officinalis* Gaertn.) cv. NA-10

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/ 100gfruitpulp), 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.

INTRODUCTION

TheIndiangooseberryoraonla(*Emblicaofficinalis*Gaerten)belongstofamily “Euphorbiaceae” with the chromosome number 2n=28. Aonla also is known indifferent names in different region like Amla, Amolphal, Amalakamu, Dhatri, Nelli,UsirikaandMaryobalan**(Sharma and Nagaich (2022).** Itisnative toIndo-China,particularlyincentralandsouthern India.In India Aonlacultivationis done mainly innorthwestHimalayastoeasternHimalaya. The domestication of Aonla was first started inVaranasi, Uttar Pradesh with the initiative of Maharaja of Kashi. Banarasi, a superiorgenotype wasselectedfromthe wild Aonlatrees are availableinlargenumberinthenearby Vindhyan hills. Authentic information regarding its cultivation dates back to1881-82inthePratapgarh districtofUttarPradesh **(Singh*etal.*,2019).** It occupies an areaof 100thousandhectareswithaproductionof1206thousandMT **(Anonymous,2021-22).** InUttarPradesh,Aonla was morecultivatedinnearby beltofPratapgarhfallowed by Ayodhya district. Area under Aonla orchard in Pratapgarh district is about1300hectares.Whereas,theareainSadderblockofdistrictofPratapgarh is approximately 3250hectares**(Rai*etal.*,2017).** Aonla is a subtropical plant and prefers dry subtropical climate but it can besuccessfullycultivatedinwiderangeofsoilsandclimaticconditions. Owingtoitshardynature,suitabilitytovariouswastelands,highproductivity,nutritiveandtherapeuticvalue

Aonlahasbecomeanimportantfruit.Aonlaisamediumsized,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. **(Tripathi *et al.*, 2022).** Sustainednutrientmanagementis thepassport toenter into the 21st century.In view of thesesituations,the application of nutrients from the combinations of inorganic, organic and biologicalsources not only fulfills the nutrient requirement of the crop but also improve the soilhealth.Henceintegratednutrientmanagementpracticeswillhelptoincreasetheproductivityofthecropa ndenrichthesoil**(Sharma*etal*.,2018)**. Organic manures supply plant nutrients and micronutrients. They improvesoilphysicalpropertieslikesoilstructure,infiltration,porosity,waterholdingcapacity, bulk density etc. Organic manures act as buffering agents andsupplies foodfor beneficiallivingorganism**(Aal *etal*.,2020)**. 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.

MATERIALS AND METHODS

Thepresentinvestigationwas carried out at Main ExperimentStation,Horticulture,AcharyaNarendraDevaUniversityofAgricultureandTechnology, Kumarganj, Ayodhya (U.P.) during the year 2021-2022. Geographically the experimental site lies between the course of Gomati andSaryu rivers (Genetics alluvium). The site is situated 42 km away from the Ayodhyadistrict headquarter and lies between a latitude of 81.12° and 83.89° at an elevation of113.0 m above mean sea level.The experimentwaslaid out in RandomizedBlock Designwith 10 treatments namely:**T_1**Control,**T_2** RDF100%(1kg.N:0.5kg.P:1kg.Kpertree), **T_3**FYM(10kg./tree)+RDF100%, **T_4**PoultryManure(7.5kg./tree)+RDF100%, **T_5**FYM(10kg./tree)+RDF50%+*Azospirillium*(10ml./tree), **T_6** Poultry Manure(7.5kg/tree)+RDF50%+*Azospirillium*(10ml./tree), **T_7**FYM(10kg./tree)+RDF50%+PSB(10ml./tree),**T_8**PoultryManure(7.5kg/tree)+RDF50%+PSB(10ml./tree), **T_9**FYM(10kg/tree)+RDF50%+*Azospirillium*(10ml./tree)+PSB(10ml./tree), and **T_{10}**PoultryManure(7.5kg/tree)+RDF50%+*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 (1990)**, several chemical parameters including total sugars, ascorbic acid, and acidity were measured. Thedataobtainedduring experimentation werestatistically analyzedas perthe method given by **Panse and Sukhatme (1985)**.

RESULTS AND DISCUSSION

TotalSolubleSolid(^{0}brix)

Results (Table 1) showed significant differenceontotalsolublesolidsoffruitsinfluencedby various treatments. Treatment T_{10}-Poultry Manure(7.5kg/tree)+RDF50%+*Azospirillium*(10ml/tree)+PSB(10ml/tree)recordedmaximum total soluble solids value (11.82^{0}Brix) followed by T_9- FYM (10kg/tree) +RDF 50% +*Azospirillium* (10ml/tree) +PSB (10ml/tree).The lowesttotal solublesolid(8.82^{0}brix)wasobservedinthe control treatment. It is assumed that TSScontentincreasedwith *Azospirillum*andFYMapplication which contributed to the quick metabolic transformation of starch and pectin into solublecompoundsandrapidtranslocation of sugarsfromleavestothedevelopingfruits leading toconversionofcomplexpolysaccharidesintosimplesugars with reference to**Kumar*etal.*(2018) who** reported that application of 100% recommended dose of fertilizers (RDF) along withvermicompost+poultrymanure+*Azospirillum*+PSBrecordedmaximumfruitTSS.Thefindings arealso in conformitywith**Babiskar*etal.*(2011)**, **Sharma*et al.* (2022)** in kiwifruit and **Jaiswal *et al.* (2023)** in guava.

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

No.	**Treatments**	**TSS(^{0}Brix)**	**Ascorbicacid(mg/100gfruitpulp)**	**Acidity(%)**	**Reducing sugar(%)**	**Non-reducing sugar(%)**	**Totalsugars (%)**
T_1	Control	8.82	488.16	2.01	2.10	1.9	4.00
T_2	RDF100%(1kgN:0.5kgP:1kgKpertree)	9.40	499.58	1.97	2.39	2.17	4.57
T_3	FYM(10kg/tree)+RDF100%	9.48	509.51	1.85	2.65	2.25	4.91

T_4	Poultry manure(7.5kg/tree)+RDF100%	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	Poultrymanure(7.5kg/tree)+RDF50%+*Azospirillium*(10ml/tree)	10.25	536.90	1.66	2.92	2.52	5.45
T_7	FYM(10kg/tree)+RDF50%+PSB(10ml/tree)	10.50	555.37	1.55	3.10	2.62	5.72
T_8	Poultry manure+RDF50%+PSB(10ml/tree)	10.58	569.63	1.49	3.16	2.88	6.04
T_9	FYM+RDF50%+*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)+RDF50% +*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

Ascorbicacid(mg./100gfruitpulp) and Acidity(%)

The highest ascorbic acid value 599.98 in Table 1 was recorded intreatmentT_{10}PoultryManure(7kg/tree)+RDF50%+*Azospirillium* (10ml/tree) + PSB (10ml/tree), followed by treatment T_9- FYM(10kg/tree) + RDF 50% + *Azospirillium* (10ml/tree) +PSB (10ml/tree). However thelowestascorbicacid488.16wasobserved in the controltreatment Theresultsindicatedthattheapplicationof FYM, *Azospirillium* and PSB had significant influence on the content of ascorbic acid in the fruit.Theseresultsareinconformitywiththefindingsof**Yadav*etal.*(2007),Bohane*etal.*(2014), Kour *et al.* (2019), Sharma *et al.* (2022)**. TreatmentsT_{10}-PoultryManure(7.5kg/tree)+RDF50%+*Azospirillium*(10ml/tree)+PSB(10ml/tree) and T_9FYM (10kg/tree) +RDF50%+*Azospirillium*(10ml/tree) reducedacidity percentandobtained minimum fruit acidity value (01.32%) followed by treatmentT_9. Thedecreaseinacidity of fruits may be attributedtotheirconversionintosugars. Similarfindingswerealsoreportedby**Bohane *et al.* (2014), Jamra*etal.*(2018), Athani(2009),Yadav*etal.*(2007)Sharma *et al.* (2022)** and **Jaiswal *et al.* (2023)** in guava**.**

Reducing and Non-reducingSugar(%)

Results (Table 1) have shown significantmaximumreducingsugar(3.28%)withapplicationofPoultryManure(7.5kg./tree)+RDF50% + *Azospirillium* (10ml./tree) +PSB (10ml./tree) followed by FYM (10kg/tree) + RDF50%+*Azospirillium*(10ml./tree).Howeverminimumreducingsugar(2.10%) was recorded in control treatmentT_1. Anincreasein reducingsugarscontentswith*Azospirillum*andFarmYardManure application could be attributed to the quick metabolic transformation ofstarchandpectinintosolublecompoundsandrapidtranslocation ofsugarsfromleaves tothedeveloping fruits as well as the conversion of complex polysaccharides intosimplesugars. Similarresultswerenotedby**Jamra*etal.*(2018), Kour *et al.* (2019)** in Aonla, **Verma*etal.(*2014)**inphalsa,**Rai*etal.*(2009)**inPear and**Chawla *etal.* (2020).** The applicationof Poultry Manure (7.5 kg/tree) + RDF 50%*Azospirillium*+(10ml/tree)+PSB(10ml/tree) (Table 1) showed significantmaximumnon-reducingsugars(3.0%)followedbyFYM(10kg/tree)+RDF50%+*Azospirillium*(10ml/tree)PSB(10ml/tree).While,minimumnon-reducingsugar(1.9%) was observed in the controltreatmentT_1. The same reason could be applied that the quick metabolic transformation ofstarchandpectinintosolublecompoundsandrapidtranslocation ofsugarsfromleaves tothedeveloping fruits. The high non-reducing sugar (2.52%) were also recorded with application of PoultryManure (7.5 kg/tree) + RDF 50% + *Azospirillium* (10ml/tree) + PSB (10ml/tree).The research findings were supported by **Verma *et al (*2014)** in Phalsa, **Chawla *etal.* (2020),Jamra *etal.*(2018) and Kour *et al.* (2019)**in Aonla.

TotalSugar(%):

In Table 1 the highesttotalsugarsvalue(6.29%)wererecordedinT_{10}treatmentthatisPoultryManure (7.5kg/tree)+RDF50% +*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 sugarpercent(4.00%) was recorded in control treatmentT_1. The findingsarecorroboratingwiththose reported by **Singh *et al.* (2008), Sharma *et al.* (2022),Kour *et al.* (2019)** in aonla fruits, **Verma *et al.* (2014)** and **Yadav *et al.*(2008)**in Phalsa.

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/ 100gfruitpulp), 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.

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.

REFERENCE

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.

Anonymous (2021-22), Indian Horticulture Database, National Horticulture Board. Department of Agriculture and Co-operation & Farmers Welfare. Government of India, Gurugram.

A.O.A.C. 1990. Official methods of analysis of 16th edition. Association of official Agricultural Chemists, Washington D.C.

Athani, S.I.; Ustad, A.I.; Prabhuraj, H.S.; Swamy, G.S.K.; Patil, P.B. and Kotikal, Y.K. (2009). Influence of vermicompost on growth, fruit yield and quality of guava cv. Sardar. *Acta Horticulture,* 735**(2):** 381-85.

Bhabiskar, M.N.; Bharad, S.G.; Dod, V.N. and Barne, V.G. (2011). Effect of integrated nutrient management on yield and quality of sapota. *Plant Archives*, 11**(2):**661-663.

Bohane L, Tiwari R. (2014). Effect of integrated nutrient management on physicochemical parameters of ber under Malwa plateau conditions. *Annals of Plant and Soil Research,* 16**(4):**346-348.

Chawla, R., and Sadawarti, R. K. (2020). Effect of bio-fertilizers and organic manures on growth, yield and fruit quality of fruit crops. *Plant Arch,* 20**(1):** 3767-3768.

Jaiswal, A., Prasad, V. M., Bhadur, V., and Kumar, N. (2023). Effect of organic manure and inorganic fertilizer on growth, yield and quality of guava (*Psidium guajava* L.), *The Pharma Innovation Journal,*12**(2):** 2133-2136.

Jamra, R., Kanwar, J., Dubey, R. and Tiwari, R. (2018). Effect of integrated nutrient management practices on physical, biochemical properties and yield of aonla (*Emblica officinalis* Gaertn). *International Journal of Chemical Studies,* 6**(2):** 1256-1258.

Kour, D., Wali, V. K., Bakshi, P., Bhat, D. J., Sharma, B. C., Sharma, V., and Sinha, B. K. (2019). Effect of Organic and Inorganic fertilizers along with Azotobacter on Growth, Yield and Quality of Aonla (*Emblica officinalis* gaertn.) Cv. Na-7. *International Journal of Current Microbiology and Applied Sciences,* 8**(9):** 1142-1151.

Kumar, A., Prasad, V.M., Singh, D., Bahadur, V., David, A.A. and Beer, K. (2018). Effect of bio-fertilizers, vermicompost and Trichoderma on yield and economics of strawberry (*Fragaria x annanasa* Duch.) cv. Sweet Charlie. *International Journal of Current Microbiology and Applied Sciences,*7**(6):** 1534-1538.

Panse, V.C. and Sukhatme, P.V. (1985). Statistical Methods for Agricultural Workers, ICAR, New Delhi.

Rai, J.; Singh, S.P. and Singh, A.K. (2017). Economics of aonla production in district Pratapgarh (U.P.). *International Research Journal of Agricultural Economics and Statistics,* 8**(2):** 426-430.

Rai, P.N., Singh, P.N. and Binayak, C. (2009). Effect of different sources of organic manures on yield and quality of low-chill pear (*Pyrus pyrifolia*) cv. Gola. *Progressive Horticulture,* 41**(1):** 103-106.

Sharma, A. and Nagaich, K. (2022). Biofertilizer–An Effective Component of Integrated Nutrient Management in Aonla. *Annals of Biology,* 38**(1):** 83-87.

Sharma, A. and Nagaich, K. (2022). Biofertilizer–An Effective Component of Integrated Nutrient Management in Aonla. *Annals of Biology,* 38**(1):** 77-82.

Sharma, B.D., Meena Anita, Jatav, M.K. and Balai, R.C. (2018). Integrated nutrient management for horticultural crops in arid region. ICAR -CIAH/ Tech./ Pub. No.77, pp 42.

Sharma, S., Rana, V. S., Rana, N., Sharma, U., Gudeta, K., Alharbi, K., and Bhat, S. A. (2022). Effect of Organic Manures on Growth, Yield, Leaf Nutrient Uptake and Soil Properties of Kiwifruit (*Actinidia deliciosa* Chev.) cv. Allison. *Plant Archives,* 11**(23):** 3354.

Singh, A.; Yadav, A.L., Yadav, D.K. and Mishra, S.K. (2008). Effect of integrated nutrient management on yield and quality of aonla (*Emblica officinalis* Gaertn.) cv. NA-10. *Plant Archives,* 8**(1):** 473- 474.

Singh, A. K., Singh, S. A. N. J. A. Y., Saroj, P. L., Mishra, D. S., Singh, P. P., and Singh, R. K. (2019). Aonla (*Emblica officinalis*) in India: a review of its improvement, production and diversified uses. *Indian Journal of Agriculture Sciences,* 89**(11):** 1773-1781.

Tripathi, V. K., and Nand, V. (2022). Effect of foliar application of Boron, Zinc and NAA on fruit retention, yield and quality attributes of Aonla. *Progressive Horticulture,* 54**(1):** 76-81.

Verma R.S.; Singh HK, Verma SS. (2014). Effect of integrated nutrient management on plant growth, fruit yield and quality of phalsa (*Grewia subinaequalis* D.C.). *Asian Journal of Horticulture,* 9**(1):**48-52.

Yadav, D.K.; Pathak, Sanjay and Yadav, A.L. (2008). Effect of integrated nutrient management on physico-chemical analysis of Phalsa (*Grewia subinaequalis* D.C.). *Plant Archives,* 8**(1):** 461-463.

Yadav, Rajesh; Singh, H.K. and Yadav; A.L. (2007). Effect of integrated nutrient management on productivity and quality of aonla (*Emblica officinalis* Gaertn). *Plant Archives* 7**(2):** 881- 883.