Original Research Article

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

ABSTRACT

Investigation was carried with aim to know the effect of integrated nutrient management on fruiting of aonla cv .Francis. The Experiment was conducted in two consecutive years. The experiment comprised of thirteen treatments, with thrice replications with randomized block design. The study revealed the Ascorbic acid , acidity , Organic carbon, Available nitrogen, Available phosphorus, available potassium percent for both the year was noted maximum with the use of T_7, which was at par withT_4, T_5,T_6 and both treatment were significantly superior over rest of the treatement. The study concluded that application of 5% RDF + 30 kg *Vermicompost*+ 250g *Azotobacter*+ 250g PSB, produced good quality fruit, yield and physiochemical attributes ofaonla for sustainable production.

Keyword: INM, ascorbic acid, acidity, attributes, aonla, Available Nitrogen, Available Phosphorus. Available Potash

1. INTRODUCTION

Aonla (*Emblicaofficinalis*Gaertn. Syn. *Phyllanthusemblica*) is indigenous fruits of the Indian subcontinent, known for itsmedicinal and therapeutic properties and considered as 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 amsl, from northwest Himalayas (Jammu & Kashmir, Himachal Pradesh, Uttarakhand) to eastern Himalayas in Assam, Meghalaya, Mizoram, Manipur and Tripura. India ranks first in production of aonla. It occupies an area of 94 thousand hectares with a production of 1098 thousand metric tons (Anonymous, 2019a). In Jammu and Kashmir State, aonla is being successfully grown in Kathua, Samba, Akhnoor, parts of Udhampur and Reasi districts on an area of 1701 ha with annual production of 3780 metric tons, respectively (Anonymous, 2019b).In Uttar Pradesh Aonla cultivation is maximum in near by belt of Pratapghar 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 an 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 vitamin C/ 100g of pulp. The fruit contains chemical substance known as leucoanthocyanins (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 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 treatment of tuberculosis of lungs, asthma, bronchitis (Kumar *et al*., 2016). It is also beneficial for the treatment of conjunctivitis, glaucoma, diabetes, rheumatism, diarrhoea and dysentery. It tones up the functions of all organs of the body and builds up health by destroying the heterogeneous elements and renewing the body 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 the use of aonla (Wali*et al.,* 2015). Besides, fruits are commonly used for preparation of preserve (murabba), pickle, candy, jelly, etc. It can be dried and powdered to be used subsequently. It is also used in the preparation of inks, hair dyes, hair oils (Tripathi*et al*., 1988).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 (Mandal *et al.,* 2013). Crop nutrition is one of the most essential factor, which greatly affect the yield and quality of aonla (Mustafa *et al.,* 2013). Fruit productivity and quality can be maintained in subsequent generation by integrated nutrient management system and contribute share in input cost of production (Singh *et al.,* 2012). 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 (Chundawat, 2001).

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 micro nutrient efficiencies.INM is a 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 (Roy and Ange, 1991). 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 (Lata*et al*., 2013).

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 from November and continuous up to the first week of March with mean temperature ranging from 15-25° C. The month 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_1:100 % RDF (1:0.5:1: N: P: K + 10kg FYM plant^{-1}), T_2:75 % RDF + 10kg *Vermicompost,* T_3:75 % RDF + 10kg *Vermicompost*+ 250g *Azotobacter*+ 250g PSB, T_4:75 % RDF + 20kg *Vermicompost* , T_5:75% RDF + 20kg *Vermicompost* + 250g *Azotobacter* + 250g PSB, T_6:75% RDF + 30kg *Vermicompost,* T_7:75% RDF + 30 kg *Vermicompost*+ 250g *Azotobacter*+ 250g PSB, T_8:50 % RDF + 10kg *Vermicompost,* T_9:50 % RDF + 10kg *Vermicompost*+ 250g *Azotobacter*+ 250 g PSB, T_{10}:50 % RDF + 20kg *Vermicompost,* T_{11}:50 % RDF + 20kg *Vermicompost*+ 250g *Azotobacter*+ 250g PSB, T_{12}:50% RDF + 30kg *Vermicompost,* T_{13}: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.

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

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.

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

Where,

MSE= Mean sum squares due to error

r= number of replication

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 investigationdata indicated that the highest ascorbic acid and acidity percentage was recorded with the application ofT_7 (75% RDF + 30 kg *Vermicompost*+ 250g *Azotobacter*+ 250g PSB) which was at par with $T_5$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* 2012a, 2012b.The improvement in fruit quality with the application of T_7were found to be better in terms of increasing the soil fertility, soil microbial & earthworm population , yield and quality of aonla fruits, Singh *et al* 2014c, 2014b .

Among the treatment the maximum organic carbon, Available Nitrogen, Available phosphorus, Available potassium were recorded with the soilapplication of T_7 (75% RDF + 30 kg *Vermicompost*+ 250g *Azotobacter*+ 250g PSB) which were found equally good with T_4, T_5T_6 and however, minimum potassium and nitrogen content the use of T_1 and result was found not significant.The maximum available nitrogen, phosphorus, and potassium were noted with the soil application of T_7 (50%NPK+50% FYM+250g each *(Azotobacter +Azospirillum* +PSB). The present study is practically supported with the findings of Katyal (1993). 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. Gourishankar (2002) 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_1	100 % RDF (1:0.5:1: N: P: K + 10kg FYM plant $^{-1}$)	1.770	1.820	475.2	479.60
T_2	75 % RDF + 10kg *Vermicompost*	1.690	1.740	491.4	495.9
T_3	75 % RDF + 10kg *Vermicompost*+ 250g *Azotobacter*+ 250g PSB	1.470	1.520	561.60	566.80
T_4	75 % RDF + 20kg *Vermicompost*	1.580	1.630	523.8	528.7
T_5	75% RDF + 20kg *Vermicompost* + 250g *Azotobacter* + 250g PSB	1.400	1.440	599.4	604.9
T_6	75% RDF + 30kg *Vermicompost*	1.550	1.600	540.0	545.0
T_7	75% RDF + 30 kg *Vermicompost*+ 250g *Azotobacter*+ 250g PSB	1.360	1.410	615.60	621.30
T_8	50 % RDF + 10kg *Vermicompost*	1.720	1.780	486.0	490.5
T_9	50% RDF + 10kg *Vermicompost*+ 250g *Azotobacter*+ 250 g PSB	1.500	1.550	550.8	555.9
T_{10}	50 % RDF + 20kg *Vermicompost*	1.640	1.700	502.2	506.8
T_{11}	50 % RDF + 20kg *Vermicompost*+ 250g *Azotobacter*+ 250g PSB	1.440	1.490	572.4	577.7
T_{12}	50% RDF + 30kg *Vermicompost*	1.610	1.660	513.0	517.8
T_{13}	50% RDF+ 30 kg *Vermicompost*+ 250g *Azotobacter*+ 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,Avaliable phosphorus and Available potassium of aonla.

Treatments		Organic carbon (%)		Available nitrogen		Avaliable phosphorus		Available potassium	
		2018	2019	2018	2019	2018	2019	2018	2019
T_1	100 % RDF (1:0.5:1: N: P: K + 10kg FYM plant^{-1})	0.39	0.39	144	146	14.30	14.46	244	246
T_2	75 % RDF + 10kg *Vermicompost*	0.39	0.42	153	160	15.15	15.84	253	260
T_3	75 % RDF + 10kg *Vermicompost*+ 250g *Azotobacter*+ 250g PSB	0.45	0.48	155	164	15.35	16.23	255	264
T_4	75 % RDF + 20kg *Vermicompost*	0.42	0.46	154	154	15.25	15.25	254	254
T_5	75% RDF + 20kg *Vermicompost* + 250g *Azotobacter* + 250g PSB	0.48	0.48	168	171	16.63	16.93	268	271
T_6	75% RDF + 30kg *Vermicompost*	0.42	0.47	155	156	15.35	15.45	255	256
T_7	75% RDF + 30 kg *Vermicompost*+ 250g *Azotobacter*+ 250g PSB	0.49	0.51	172	166	17.02	16.44	272	266
T_8	50 % RDF + 10kg *Vermicompost*	0.39	0.42	151	155	14.95	15.05	251	255
T_9	50% RDF + 10kg *Vermicompost*+ 250g *Azotobacter*+ 250 g PSB	0.44	0.47	155	158	15.35	15.64	255	258
T_{10}	50 % RDF + 20kg *Vermicompost*	0.40	0.44	153	164	15.15	16.24	253	264
T_{11}	50 % RDF + 20kg *Vermicompost*+ 250g *Azotobacter*+ 250g PSB	0.46	0.48	157	155	15.54	15.35	257	255
T_{12}	50% RDF + 30kg *Vermicompost*	0.45	0.46	154	155	15.25	15.35	254	254
T_{13}	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

CONCLUSION

On the basis of finding of 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 treatement 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

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