International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(3): 1703-1706

Received: 10-03-2018
Accepted: 12-04-2018

Shashi
Department of Horticulture, Sam Higginbottom Institute of Agriculture Technology and Science, Allahabad, Uttar Pradesh, India

Vijay Bahadur
Department of Horticulture, Sam Higginbottom Institute of Agriculture Technology and Science, Allahabad, Uttar Pradesh, India

Rajneesh Srivastava
Department of Horticulture, Sam Higginbottom Institute of Agriculture Technology and Science, Allahabad, Uttar Pradesh, India

Suresh Kumar Teli
Department of Horticulture, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan, India

Correspondence
Shashi
Department of Horticulture, Sam Higginbottom Institute of Agriculture Technology and Science, Allahabad, Uttar Pradesh, India

Effect of foliar application of liquid fertilizers and micronutrients on fruit quality and shelf life of Aonla (*Emblica Officinalis*)

Shashi, Vijay Bahadur, Rajneesh Srivastava and Suresh Kumar Teli

Abstract
The result showed that the application of higher concentration (10%) of NPK liquid fertilizer gave the better result in terms of length of fruit (32.50 mm), diameter of fruit (41.62 mm), T.S.S. (14.58 ^{0}B), Vitamin-C content (565.68 mg/100gm of pulp) with minimum acidity percentage (1.98 %) and longest shelf life of aonla fruit. Among the different levels of micronutrients, application of micronutrients @ of 5% gave the better results in cash of length of fruit (31.46 mm) and diameter of fruit (40.09 mm), highest total soluble solid (13.57 ^{0}B), highest Vitamin-C (mg/100g of pulp), i.e.563.37 mg, lowest acidity (2.08%) with maximum shelf life (5.25 days) which was at par with micronutrients application @ 7.5%. Among the combinations of liquid fertilizers and micronutrients, the combination effect of NPK_3 (10%) & MN_1 (5%) gave the better quality and long shelf life. From the foregoing discussion it can be concluded that higher concentration (10%) of NPK liquid fertilizer and Micronutrient mixture (5%) found effective for better fruit quality and long shelf life.

Keywords: Aonla, micronutrients, liquid fertilizers, shelf life, TSS and quality

Introduction
The aonla (*Emblica officinalis*) is one of the most important indigenous fruits of India, which is also known as 'Indian gooseberry' belongs to family Euphorbiaceae. It is native to Tropical South-East Asia, particularly Central and South India (Firminger, 1947 and Morten, 1960) [5]. In India aonla is grown since ancient times due to its religious, nutritional and therapeutic values. Aonla finds mention in 'Vedas', 'Ramayan', 'Charak Samhita', 'Sushrut Samhita' and other ancient Indian literatures describing its fruit highly valuable as food, medicine and hair dye (Anonymous, 1964, Chopra *et al*., 1958) [2, 4]. Aonla is the main ingredient of health booster 'Chavanprash' and constitute of 'Trifala' (three fuits) powder, which is prescribed in many digestive disorders. Aonla is primarily a sub-tropical arid fruit crop but it has vast potential and wider adaptability to grow under variable agro-edaphic conditions *viz*., arid and semi to dry hot and cold arid regions, rain fed to rainfall area. India is a largest producer of Aonla in the world with the production of 1266000 tons in 108000 ha area (Department of Agriculture and Cooperation, 2014). During a last decade, the commercial cultivation of aonla was expanded in almost all the states of India, because of its high nutritional values, wider adaptability and economic importance. However, the traditional cultivation of aonla predominantly is occupied in Uttar Pradesh, particularly in Pratapgarh, Sultanpur, Varanasi, Kanpur and Agra districts. Pratapgarh district has been declared as aonla fruit belts and Agri-expo zone. Now-a-days, many complaints are coming from growers that there is heavy pre-mature fruit drop in aonla during August-October. This couples another problem of inferior quality fruits leading to low profitability. This may be due to many reasons one of them, mostly aonla is grown in barren soil and farmer does not spray nutrients after the flowering, browning and internal necrosis are serious problems in this crop, which were reported due to micronutrients deficiency. The foliar application of macro (NPK) and micro nutrients have immense important role in improving fruit set, productivity and quality of fruits. It has also beneficial role in recovery of nutritional and physiological disorder in fruit trees. Various experiments have been conducted earlier on foliar spray of micro-nutrient in different fruit crops and shown significant response with improvement of yield and quality of fruits (Singh *et al.* 2001) [15]. Foliar application is based on the principle that the nutrients are quickly absorbed by leaves and transported to different parts of the plant to fulfill the functional requirement of

nutrition. Foliar application of the nutrient is obviously an ideal way to evading the problem of nutrient availability. This method has been commercialized in a number of fruits, like citrus, pineapple, and guava etc. Indian gooseberry being minor fruit crops no systematic research work has been carried out for improving fruit set, yield and quality of aonla fruit by foliar spray of micro and macro nutrient. A sporadic research works have been carried out so far to overcome the problem of heavy pre-harvest fruit drop, improving the fruit yield and quality of aonla cv. NA-6 grown under degraded sodic lands having low soil fertility levels. Thus, keeping in view, the problem of pre-mature fruit drop, poor yield and fruit quality of aonla, the present investigation entitled "Effect of Foliar Application of Liquid Fertilizers and Micronutrients on Yield, Quality and Shelf life of Aonla (*Emblica officinalis*)" was undertaken.

Materials and Methods

The present investigation "Effect of foliar application of liquid fertilizers and micronutrients on fruit quality and shelf life of aonla (*Emblica officinalis*)" was carried out at the Horticulture Research Farm, Department of Horticulture, Allahabad School of Agriculture, Sam Higginbottom Institute of Agriculture, Science and Technology, Allahabad. During the winter season of year 2015-2016. For this four levels of liquid fertilizers (Amikar) (N:P:K - 19:19:19) *i.e.* NPK_0 – 0 %, NPK_1 –5 %, NPK_2 –7.5 %, NPK_3 –10 % and four levels of micronutrients mixture (Zn: 0.2%, B:0.2%,Cu:0.1%, Fe:0.1%) MN_0 –0%, MN_1–5%, MN_2 –7.5%, MN_3–10% were studied. The experiment was laid out in Factorial Randomized Block Design with sixteen treatment combination replicated thrice. The treatments comprised of sixteen combinations of liquid fertilizers and micronutrients viz., T_1 (NPK_0MN_0)- NPK 0 % + Micronutrient 0% (Control), T_2 (NPK_0MNN_1)- Micronutrient 5% NPK alone, T_3 (NPK_0MN_2)- Micronutrient 7.5% NPK alone, T_4 (NPK_0MN_3)- Micronutrient 10% NPK alone, T_5 (NPK_1MN_0)– NPK 5 %, T_6 (NPK_1MN_1)- NPK 5 %+ Micronutrient 5%, T_7 (NPK_1MN_2)- NPK 5 %+ Micronutrient 7.5%, T_8 (NPK_1MN_3)- NPK 5 % + Micronutrient 10%, T_9 (NPK_2MN_0)- NPK 7.5 %, T_{10} (NPK_2MN_1)- NPK 7.5 % + Micronutrient 5%, T_{11} (NPK_2MN_2)- NPK 7.5 % + Micronutrient 7.5%, T_{12} (NPK_2MN_3)- NPK 7.5 %+ Micronutrient 10%, T_{13} (NPK_3MN_0)- NPK 10 %, T_{14} (NPK_3MN_1)- NPK 10 % + Micronutrient 5%, T_{15} (NPK_3MN_2)- NPK 10 % + Micronutrient 7.5% and T_{16} (NPK_3MN_3)- NPK 10 % + Micronutrient 10%. The solutions were prepared as per required concentrations of nutrients (Liquid Fertilizers and Micronutrients). The required quantity of chemicals/salts was weighed using balance and dissolved in distilled water in measuring cylinder. The dissolved solution was diluted and volume made up to 10 liters in plastic buckets as per required quantity of solutions. The foliar sprays of nutrients were applied thrice after fruit set. The first spray of nutrients was applied during First week of September 2015 and second sprays after one month of first spray i.e. First week of October and Third sprays one month of second spray i.e. First week of November at the time of fruit development stage using Aspen pneumatic foot sprayer fitted with nozzle. The data on quality parameters like length and diameter of fruit (mm) were measured in centimeter with the help of calibrated Vernier Callipers at fruit maturity/harvesting stage. The ten number fruits collected from the tagged branches were measured for average size of fruit. The total soluble solids of the fruit juice were determined by using of hand refractometer with the help of muslin cloth. (Model- Fisher, Japan range 0-50 per cent) and the value was corrected at 20 ^{0}C and expressed as per cent. Ascorbic acid content of fruit was estimated by grinding five gram of fruit pulp with 3 per cent met phosphoric acid as buffer. The extract was filtered and volume made up to 100ml. The 5ml aliquot was titrated against 2, 6 dichlorophenol indophenols dye solution till light pink colour appeared. The value were calculated using the following formula and expressed as mg ascorbic acid per 100g fruit pulp (AOAC. 1980) [3].

$$\text{Ascorbic acid} = \frac{\text{Titre value x dye factor x volume made up}}{\text{Weight of sample taken for estimation}} \text{ x } 100$$

The titrable acidity was estimated against 0.1 N Sodium Hydroxide (NaOH) solution using phenolphthalein as an indicator. The end point was observed upon appearance of light pink colour which persisted for 20-30 seconds. Ten gram of fruit pulp was macerated and diluted in a small amount of distilled water and filtered through muslin cloth. The volume was made up to 100ml. Out of that 5ml aliquot was taken. The per cent of acidity expressed in per cent citric acid using following formula (Ranganna, 2001) [11].

$$\text{Titratable acidity (\%)} = \frac{\text{Titrable value x normality of NaoH x 64 volume made up}}{\text{Aliquot taken x weig ht of sample x 1000}} \text{x100}$$

However, the data on shelf life parameters of fruit viz., Physiological weight loss after 15 days of harvest and Shelf life after storage at room temperature of aonla fruit were calculated accordingly. The data collected from different characters was processed and analyzed by the method of analysis of variance as derived by (Fisher, 1936) [6].

Results and Discussion

In the present investigation, results so obtained are presented in the Table 1

Effect of liquid fertilizers

The results showed that the foliar application of NPK have beneficial effect on quality and shelf life of fruits of aonla. Among the different level of liquid fertilizers, NPK_3 (10 %) recorded significantly the maximum length of fruit (32.50 mm), maximum diameter of fruit (41.62 mm), maximum total soluble solid (14.58 ^{0}B), maximum Vitamin-C (mg/100g of pulp) (565.68 mg), minimum acidity (1.98 %), minimum physiological weight loss i.e. 11.58 g, maximum shelf life after storage at room temperature was recorded in treatment NPK_3 i.e. 6.20. The water soluble compounds in developing fruits might increase due to various nutrients. The present finding are also in agreement with the observation recorded in guava cv. Sardar by Singh *et al.* (2009) [12]. The application of urea, magnesium and zinc sulphate increase ascorbic acid in in aonla fruit cv. Banarasi. Singh *et al.* (2012) [17].

Effect of micro nutrients

The results (Table1) showed that the foliar application of micro nutrients have beneficial effect on yield, quality and shelf life of fruits of aonla fruits. Among the different levels of micronutrients significantly the maximum length of fruit i.e. 31.46 mm and diameter of fruit i.e. 40.09 mm, highest total soluble solid (^{0}Brix) i.e. 13.57 ^{0}B, highest Vitamin-C (mg/100g of pulp), i.e.563.37 mg, lowest acidity, i.e. 2.08 % with maximum shelf life (5.25 days) was recorded in MN_1 (5%) which is statistically at par with MN_2 (7.5 %). Whereas

the minimum physiological weight loss (13.47 g) was recorded in MN_3 (10 %) which was statistically at par with MN_1 (5 %) and MN_2 (7.5 %). The involvement of micronutrients directly in growth and magnesium indirectly through translocation of food material might be responsible to improve the weight and volume of fruits. In case of the T.S.S. of fruits might be mainly due to the influence of boron and zinc. Boron is responsible for sugar metabolism and accumulation of carbohydrates (Sourour, 2000) [18]. Whereas, zinc plays a roles in photosynthesis and related enzymes which helps in the further accumulation of carbohydrates (Abedy, 2001) [1]. The reason for lower acidity might lies with the conversion of acid under influence of micronutrients by reactions involving reversal of glycolytic pathway (Ruffner *et al.*, 1975) [12]. The results are close conformity with the finding of Singh *et al.* (2007) [16] and Sharma *et al*. (2016) [13]. Similar results were also obtained by Ghose *et al.* (2009) in aonla cv. NA-10 by spray of Zinc (0.5%). The increase in ascorbic acid content of fruit juice was due to increase synthesis of catalytic enzymes and co-enzyme which are represented ascorbic acid and synthesized. These results are in close conformity with the findings of Ghose *et al.* (2009) that the spray of zinc sulphate and borax increase ascorbic acid in Aonla, Singh *et al.* (2001) [15] with ZnSO4, CuSO4 and Borax in aonla. It is evident from the result that Vitamin-C content in fruit might be improved with application of micro-nutrients. The decrease in acidity percentage might due to transformation of organic acid into sugars at the time of ripening. Similar results were also obtained with combined application of zinc sulphate in pear cv. Patharnakh by Singh *et al.* (2001) [15]**,** Singh *et al.* (2012) [17] in aonla fruit cv. Banarasi and Kumar *et al*. (2015) [9] in guava cv. Pantprabhat. The foliar spray of plant growth regulators and micronutrients improve the physico-chemical quality and shelf life of aonla fruit cv. Banarasi Yadav *et al.* (2009) [19].

Interaction effect

The combination of NPK_3 & MN_1 recorded significantly maximum length of fruit (33.01 mm), maximum diameter of fruit (42.12 mm), highest total soluble solid (15.30 ^{0}B), maximum vitamin-C content (568.51 mg 100g of pulp), lowest acidity (1.94 %) with maximum shelf life (6.86 days). While the minimum physiological weight loss (11.25 g) was recorded in NPK_3 & MN_2 which was statistically at par with the NPK_3 & MN_1. In case of fruit size the combined spray of zinc sulphate and urea increase the size of fruit of aonla cv. NA-6 Khan *et al.* (2009) [8].

Table 1: Effect of foliar application of liquid fertilizers and micronutrients on Length of fruit, Fruit diameter, T.S.S., Vitamin-C, Acidity, PLW and Shelf life of fruit of aonla (*Emblica officinalis*).

Treatments	Length of fruit(mm)	Fruit diameter (mm)	T.S.S. (^{0}Brix)	Vitamin-C (mg/100g pulp)	Acidity (%)	PLW (g) after 15 days of harvesting	Shelf life at room temp.
NPK_0 (0%)	29.21	36.65	11.25	557.40	2.26	17.22	3.44
NPK_1 (5%)	30.52	38.76	12.46	560.44	2.17	15.07	4.98
NPK_2 (7.5%)	31.30	39.81	13.22	562.17	2.11	12.87	5.52
NPK_3 (10%)	32.50	41.62	14.58	565.68	1.98	11.58	6.20
S. Ed (±)	0.10	0.15	0.04	0.22	0.03	0.10	0.09
C.D. at 5%	0.22	0.32	0.08	0.45	0.07	0.22	0.19
MN_0 (0%)	30.37	38.47	12.36	559.95	2.18	14.78	4.73
MN_1 (5%)	31.46	40.09	13.57	563.37	2.08	14.39	5.25
MN_2 (7.5%)	31.29	39.90	13.21	562.33	2.09	14.10	5.04
MN_3 (10%)	30.41	38.39	12.36	560.04	2.14	13.47	5.13
S. Ed (±)	0.10	0.15	0.04	0.22	0.03	0.10	0.09
C.D. at 5%	0.22	0.32	0.08	0.45	0.07	0.22	0.19
NPK X MN	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
C.D. at 5%	0.44	0.64	0.16	0.91	0.07	0.44	0.38

References

1. Abedy A. Effects of zinc sulphate and citric acid spray on fruit characteristics of tomato cultivar 'Urbana'. M.Sc. Thesis, Shiraz University, 2001.
2. Anonymous. Agriculture in ancient India. Ray chaudhary, S.P. (Tech. Edn.) I.C.A.R., New Delhi, 1964.
3. AOAC. Official method of analysis. Association of Official Agricultural Chemists. Benjamin Franklin Station, Washington, DC, 1980, 16-37.
4. Chopra RN, Chopra IC, Handa KL, Kapur LD. Chopra's indigenous drugs of India (2nd Edn.) U.N. Dhur and Sons Pvt. Ltd., Calcutta, 1958.
5. Firminger TA. Firminger manuals of gardening for India. Eighteth Edition, Tacker, Spink and company Limited Calcutta, India, 1947.
6. Fisher RA, Yates AH. Statistical tables for biological, agricultural and medical research. Olivar and Boyed, Edinburgh, 1936, 134-135.
7. Ghosh SN, Bera B, Roy S, Kundu A, Roy SKD. Effect of nutrients and plant growth regulators on fruit retention, yield and physico-chemical characteristics in aonla cv. NA-10. J of Horticultural Sciences. 2009; 4(2):164-166.
8. Khan S, Singh HK, Vishwanath, Pratap B. Influence of foliar feeding of nutrients and Thiourea on fruit yield and quality of Aonla (*Emblica officinalis* Gaertn.) cv. NA-6. Annals of Horticulture. 2009; 2(1):89-91.
9. Kumar J, Kumar R, Rai R, Mishra DS. Response of 'pant prabhat' guava trees to foliar sprays of zinc, boron, calcium and potassium at different plant growth stages. The Bioscan. 2015; 10(2):495-498.
10. Morton JF. The Emblica (*Phyllanthus emblica* L.). Economic Botany. 1960; 14:119-127.
11. Ranganna S. Manual of analysis of fruits and vegetable products, Tata Mc Graw Hill publication Company Ltd., New Delhi, India, 2001.
12. Ruffner HP, Koblet W, Rast D. Gluconeogenase in Riefenden Beeren von Vitis vinifera. Vitis. 1975; 13:310-328.
13. Sharma KM, Singh V, Amarcholi JJ, Momin S. Response of different concentrations of urea, KNo_3 and micronutrient mixture on quality of sapota (*Manilkara achras* (mill.) Fosberg) cv. Kalipatti. The Bioscan. 2016; 11(1):417-419.

14. Singh DM, Singh HK, Vishwanath, Pratap B. Effect of foliar feeding of nutrients on yield and quality of aonla fruits (*Emblica officinalis Gaertn.*). Annals of Horticulture. 2009; 2(1):95-97.
15. Singh HK, Srivastava AK, Dwivedi R, Kumar P. Effect of foliar application on internal fruit necrosis of aonla (*Emblica officinalis* Gaertn.) cv. Francis. Progressive Horticulture. 2001; 33(1):80-83.
16. Singh JK, Prasad J, Singh HK. Effect of micro-nutrients and plant growth regulators on yield and physico-chemical characteristics of aonla fruit in cv. Narendra Aonla-10. Indian Journal of Horticulture. 2007; 64(2): 216-218.
17. Singh PC, Gangwar RS, Singh VK. Effect of micronutrients spray on fruit drop, fruit quality and yield of aonla cv. Banarasi. Hort Flora Research Spectrum. 2012; 1(1):73-76.
18. Sourour MM. Effect of foliar application of some micronutrients forms on growth, yield, fruit quality and leaf mineral composition of Valencia orange trees grown in North Sinai. Alexandria J Agri. Res. 2000; 45(1):269-285.
19. Yadav S, Shukla HS. Effect of Various Concentrations of Plant Growth Regulators and Mineral Nutrients on Quality Parameters and Shelf Life of Aonla (*Emblica officinalis* Gaertn.) Fruit. Indian Journal Agriculture Biochemistry. 2009; 22(1):51-56.