

Original Research Article

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Effect of Foliar Feeding of Micro-nutrients on Physico-Chemical Attributes of Aonla (*Emblica officinalis* Gaertn) cv. Na-7 Under High Density Planting

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ABSTRACT

The present investigation entitled on “Effect of foliar feeding of micro-nutrients on physico-chemical attributes of aonla (*Emblica officinalis* Gaertn) cv. Na-7 under high density planting” was carried out at the Main Experimental Station, Department of Horticulture, NDUAT, Kumarganj, and Faizabad (U.P.) during the year 2015-16. The experiment on aonla cv. NA-7 was conducted in Randomized Block Design (RBD) with three replication and seven treatments such as T₁ (control), T₂ (ZnSO₄ @ 0.25%), T₃ (Borax @ 0.25%), T₄ (CuSO₄ @0.4%), T₅ (MnSO₄ @ 0.5%), T₆ (CuSO₄ @ 0.4%) + ZnSO₄ (0.25%) + Borax (0.25%) and T₇ (CuSO₄ @ 0.4%) + MnSO₄ (0.5%) + ZnSO₄ (0.25%) considering one plant as unit (used 21 trees in overall research) con. The micro nutrient spray was applied two times after fruit set in the month of mid of May and July. The observations were recorded on per cent fruit drop and fruit retention, fruit size, fruit weight, stone weight, pulp: stone ratio, fruit yield and quality at different stages of fruit development. The minimum (75.03%) per cent of fruit drop and maximum per cent of fruit retention (24.80%) was recorded with CuSO₄ (0.4%) + ZnSO₄ (0.25%) + Borax (0.25%). Significant increase in fruit size, fruit weight (42.70g), pulp: stone ratio (21.59) was also recorded due to treatment CuSO₄ (0.4%) + MnSO₄ (0.5%) + ZnSO₄ (0.25%) as compared to other treatments. The maximum TSS (12.35%), reducing (3.05%), non-reducing (2.58%) and total sugars (5.63%), Vitamin ‘C’ (560.5 mg/100g of fruit pulp) and fruit yield (99.04 kg/tree) recorded with treatment of CuSO₄ (0.4%) + ZnSO₄ (0.25%) + Borax (0.25%) whereas minimum acidity (1.37%) and stone weight(1.86g) were also recorded with foliar feeding of CuSO₄ (0.4%) + ZnSO₄ (0.25%) + Borax (0.25%). On the basis of present finding, it can be concluded that foliar feeding of CuSO₄ (0.4%) + ZnSO₄ (0.25%) + Borax (0.25%) gave best result for the production of maximum fruit yield and better quality of aonla fruits.

Keywords

Aonla,
Micro-nutrients,
Physico-chemical,
Zinc, Manganese
sulphate

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Introduction

Aonla is also known as Indian Gooseberry and has scientific name as *Emblica officinalis* Gaertn syn. *Phyllanthus emblica* L. belong to family Euphorbiaceae and sub family phyllanthoidae, is an important fruit crop of

commercial significance. It is native to tropical region of the South-East Asia, particularly Central South India. It is being cultivated since long back and occupies an important place among the indigenous fruits

of India. It is more popular in India and is commercially cultivated in Uttar Pradesh. Intensive plantation of aonla is being done in the salt affected district of U.P. including ravenous area of Agra, Mathura, Etawah, arid and semiarid regions of Maharashtra, Gujrat, Andhra Pradesh, Rajasthan, Karnataka etc. Aonla is an important fruit of future due to its medicinal as well as nutritive value. It has been recognized as 'Amritphal' (Life saving fruit) and 'Wonder drug' for its significance to health, wealth, vitality and other ancient Indian literatures describing its fruits as highly valuable food, medicine and hair dye. Aonla ought to be an important fruit in near future; it is richest source of vitamins 'C' among fruits except Barbados cherry. The variations in ascorbic acid content have been recorded by various workers. It is also a fair source of carbohydrate (14%), protein (0.5%), vitamin 'B' (30mg/100g) and minerals particularly iron (1.2%), phosphorous (0.2%), calcium (0.05%), magnesium and fibre (3.4%). Beside these, aonla fruit has adequate amount of acids and sugars. The fruit are used to make preserve, candy, dried chips, pickles, triphala powder, chyavanprash etc. and possess diverse medicinal and industrial used. The fruit contains a chemical substance Gallic acid and leuco-anthocyanin which have anti-oxidant property. Aonla is drought hardy fruit crop which is characterized by deep root system and exhibits deciduous nature due to abscission and shedding of determinate shoot during February and March.

Various experiments have been conducted earlier on foliar spray of micro-nutrient in different fruit crops and shown significant response with improvement of physical attributes and quality of fruits (Kumar *et al.*, 2004, Bhatia and Yadav (2003) and Singh *et al.*, (2015) However it has been studies the physiological, biochemical and biological activities in plant system are highly influenced due to interaction of micro

nutrients. Among the foliar application of different level of nutrients viz. Zinc, copper and manganese have been found more effective in improving the flowering, fruit set, fruit size, fruit retention in number of fruit crops. Micronutrients influenced quality of fruits (Sourour *et al.*, 2000; Singh *et al.*, 2001; Shekhar *et al.*, 2010).

Materials and Methods

The present investigation entitled "Effect of foliar feeding of micro-nutrients on yield of aonla (*Emblica officinallis* Gaertn L.) cv. Narendra Aonla-7 (21 Years old) under high density planting" was carried out during the year 2015-16 at Main Experiment Station, Department of Horticulture, Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad (U.P.) during the year 2015-16. The experiment was laid out in a Randomized Block Design with seven treatments such as T₁ (control), T₂ (ZnSO₄ @ 0.25%), T₃ (Borax @ 0.25%), T₄ (CuSO₄ @0.4%), T₅ (MnSO₄ @ 0.5%), T₆ (CuSO₄ (0.4%) + ZnSO₄ (0.25%) + Borax (0.25%)), T₇ (CuSO₄ (0.4%) + MnSO₄ (0.5%) + ZnSO₄ (0.25%) and replicated thrice. First foliar spray of micro-nutrients is done in May 15th however, second foliar spray of micro-nutrients is done of 15th July. during the year 2015-16 at Main Experiment Station, Department of Horticulture, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U. P).

Results and Discussion

It has been observed that the foliar feeding of various micro-nutrients proved the beneficial for increasing length, width, weight, Pulp/stone ratio fruit, total sugars, TSS and reducing the stone weight, acidity of aonla fruit in comparison to control (Singh *et al.*, 2015; Sharma *et al.*, 2003; Rajput *et al.*, 2013; Kumar *et al.*, 2014; Kumar *et al.*,

2004). The results clearly indicated that fruit size was markedly improved by all the micro-nutrients over control. The maximum fruit size in terms of fruit length (3.86 cm) was recorded with combined foliar feeding of Copper sulphate (0.4%) + Magnesium sulphate (0.5%) + Zinc sulphate (0.25%) followed by copper sulphate (0.4%) with the superior over rest significant and maximum width (4.11 cm) was recorded with combined foliar feeding of Copper sulphate (0.4%) + Magnesium sulphate (0.5%) + Zinc sulphate (0.25%) followed by Copper sulphate (0.4%) + Zinc sulphate (0.25%) + Borax (0.25%). The result is in closely conformity with the finding of Kumar *et al.*, (2004) in litchi, Yadav *et al.*, (2010) in papaya, Singh *et al.*, (2001) and Verma *et al.*, (2008) in aonla.

Increase in fruit size with spraying of Zinc might be attributed to efficient absorption and consequently more luxuriant vegetative and reproductive growth in initial stage which influenced the activity of metabolism in plant which attributed to better development of fruit. The copper maintains leaf color due to increasing of carotene and other pigments. Copper influenced the activity of metabolism in plant because its role as catalyst and regulator. However, Spraying of Borax, which provides boron to the plant, might have regulated the cell-wall permeability, thereby allowing more mobilization of water in fruit attributing to larger fruit size.

The weight of fruit was improved significantly by all the micro-nutrients over control except Manganese sulphate. However, the maximum fruit weight (42.70 g) was recorded with the combined spray of Copper sulphate (0.4%) + Magnesium sulphate (0.5%) + Zinc sulphate (0.25%) followed by Borax (0.25%) whereas minimum fruit weight recorded in control plants. The involvement of zinc directly in growth and magnesium indirectly through translocation of food

material might be responsible to improve the weight of fruits. These results are in close conformity with the findings of Usha and Singh (2002) in grape Singh *et al.*, (2001) and Singh *et al.*, (2012) in aonla. However, data with respect to stone weight revealed that there were no statistical differences in values obtained under different treatments. The lowest stone weight (1.86) was found spray of Copper sulphate (0.4%) + Zinc sulphate (0.25%) + Borax (0.25%). The highest (21.71) pulp-stone ratio was observed with combined spray of T₇ Copper sulphate (0.4%) + Manganese sulphate (0.5%) + Zinc sulphate (0.25%) followed by T₂ Zinc sulphate (0.25%). The lowest (15.75) pulp ratio was obtained under control. The pulp stone ratio was significantly improved by all chemicals over control except Manganese sulphate.

There is little information available for pulp/stone ratio of aonla but Singh *et al.*, (2004) reported that spray of urea, magnesium sulphate and zinc sulphate increase the pulp stone ratio of aonla fruit. Zinc and boron improves fruit quality (Brahmhchari *et al.*, 2001; Babu and Singh, 2001; Birendra *et al.*, 2000; Sharma *et al.*, 2005; Kar *et al.*, 2002; Saraswathy *et al.*, 2005; Singh *et al.*, 2008; Ghosh *et al.*, 2009; Lokesh *et al.*, in papaya and Malik *et al.*, 1990 in kinnow mandarin).

The increase in pulp: stone ratio might be due to the acceleration in biochemical activities and accumulation of metabolites in plant parts, which is probably due to synergistic effect of Zinc and Copper on conversion and translocation of total sugars and minerals during the process of fruit development and fruit maturation. Similar observations were recorded by Singh *et al.*, (1993) in aonla, Sharma *et al.*, (2004) in litchi, Babu and Singh (2001) in Litchi. The importance of the elements in improving the physiological activities of plant had been released but it is not clear in whether directly or indirectly.

Chemical characters of fruit

The maximum (12.35%) accumulation of total soluble solids content in aonla fruit was found with combined foliar feeding of Copper sulphate (0.4%) + Zinc sulphate (0.25%) + Borax (0.25%) followed by Copper sulphate (0.4%) + Magnesium sulphate (0.5%) + Zinc sulphate (0.25%). The lowest was recorded under control. However, the promoting effect was also observed by almost all micro-nutrients over control. Thus, it seems logically that an increase in permeability permitted the acid particular citric acid stored in cell vacuoles for break down by respiration at faster rate. Transfer of organic acid into sugars is one of the reasons for increasing the TSS content of fruits. During ripening carbohydrate converts into simplest form of sugars which may ultimately increase the TSS content of fruits. Zinc have great role in improving fruit quality supported by Sharma 2002, Sharma 2003, Sharma 2008, The results are close conformity with the finding of Singh *et al.*, (2001) in aonla and Yadav *et al.*, (2010) in papaya. Total sugars, reducing sugars and non-reducing sugar contents were found in aonla fruit as influenced by different treatments of micro-nutrients. The maximum reducing sugars (3.05%) have been recorded with the foliar feeding of Copper sulphate (0.4%) + Zinc sulphate (0.25%) + Borax (0.25%) followed by Manganese sulphate (0.5%). The maximum non-reducing (2.58%) and total sugars (5.63%) were observed with the spray of Copper sulphate (0.4%) + Zinc sulphate (0.25%) + Borax (0.25%) followed by Copper sulphate (0.4%) (Singh *et al.*, 2004) and (Singh *et al.*, 2007). All the treatments of micro-nutrients were found to reduce the acid content of fruits as compared to control. The lowest acid (1.37%) content was observed with combined foliar feeding of Copper sulphate (0.4%) + Zinc sulphate (0.25%) + Borax (0.25%) followed by Copper sulphate (0.4%).

The highest acidity was noted with control. Such type of results might due to transformation of organic acid into sugars at the time of ripening. Likewise, similar results were obtained by (Singh *et al.*, 2007) and Singh *et al.*, (2001) in aonla. Ascorbic acid is major and chemical constituent of aonla fruit, the Ascorbic acid content of aonla significantly affected by variable genotype, nutritional status of plant, soil and environmental temperature. Significantly maximum ascorbic acid content (526.97 mg/100gm) was recorded with application of Copper sulphate (0.25%) + Zinc sulphate (0.25%) + Borax (0.25%) followed by Copper sulphate (0.4%), the minimum ascorbic acid content found in control. 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. It is evident from the result that vitamin-‘C’ content in fruit might be improved with application of micro-nutrients. These results are enclosed conformity with the findings of Singh *et al.*, (2001), (Singh *et al.*, (2007) and (Singh *et al.*, 2012) in aonla. The maximum (3.86 cm) fruit length was obtain with combined spray of T₇ Copper sulphate (0.4%) +Manganese sulphate (0.5%)+ Zinc sulphate (0.25%) followed by combined spray of T₄ Copper sulphate (0.4%) while the minimum (3.15 cm) fruit length was recorded under control. However, Treatment T₆Copper sulphate (0.4%) + Zinc sulphate (0.25%) + Borax (0.25%) is statistically at par with T₇ respectively. The highest fruit width (4.11 cm) was obtained with the combined spray of T₇ Copper sulphate (0.4%) + Manganese sulphate (0.5%) + Zinc sulphate (0.25%) followed by combined spray of T₆ Copper sulphate (0.4%) + Zinc sulphate (0.25%) + Borax (0.25%) while minimum (3.45 cm) fruit width was recorded under control treatment respectively.

Table.1 Effect of foliar feeding of micro-nutrients on fruit width, fruit length, pulp/stone ratio and fruit weight of aonla

Treatments	Fruit width (cm)	Fruit length (cm)	Pulp/stone ratio	Fruit Weight (g)
T ₁ : Control (Water spray)	3.45	3.15	15.75	31.56
T ₂ : Zinc sulphate (0.25%)	3.74	3.58	20.07	39.7
T ₃ : Borax (0.25%)	3.65	3.49	18.84	37.1
T ₄ : Copper sulphate (0.4%)	3.8	3.65	20.4	40.3
T ₅ : Manganese sulphate (0.5%)	3.55	3.32	17.04	33.7
T ₆ : CuSO ₄ (0.4%) + ZnSO ₄ (0.25%) + Borax (0.25%)	3.92	3.72	21.59	42.10
T ₇ : CuSO ₄ (0.4%) + MnSO ₄ (0.5%) + ZnSO ₄ (0.25%)	4.11	3.86	21.71	42.7
SEm±	0.05	0.05	0.43	1.12
CD at 5%	0.15	0.15	1.33	3.45

Table.2 Effect of foliar feeding of micro-nutrients on TSS, reducing sugars, non-red, sugars, total sugar, acidity, ascorbic acid content

Treatments	Total soluble solids (TSS) %	Reducing Sugars %	Non Reducing sugar	Total Sugar %	Acidity	Ascorbic acid (mg/100 g pulp)
T ₁ : Control (Water spray)	9.72	2.46	2.10	4.56	1.67	470.82
T ₂ : Zinc sulphate (0.25%)	11.20	2.86	2.44	5.30	1.52	502.26
T ₃ : Borax (0.25%)	10.87	2.82	2.40	5.22	1.56	496.89
T ₄ : Copper sulphate (0.4%)	11.30	2.89	2.46	5.35	1.48	509.36
T ₅ : Manganese sulphate (0.5%)	10.70	2.75	2.37	5.12	1.60	487.29
T ₆ : CuSO ₄ (0.4%) + ZnSO ₄ (0.25%) + Borax (0.25%)	12.35	3.05	2.58	5.63	1.37	526.97
T ₇ : CuSO ₄ (0.4%) + MnSO ₄ (0.5%) + ZnSO ₄ (0.25%)	12.05	2.94	2.53	5.47	1.40	520.48
SEm±	0.24	0.07	0.03	0.07	0.04	4.39
CD at 5%	0.74	0.23	0.09	0.23	0.12	13.52

Data recorded on average fruit weight (g) of aonla cv. NA-7 as influenced by foliar spray of micro-nutrients is presented in Table 4.6 and Fig. 6. The maximum (42.70 g) fruit

weight was observed due to combined spray of T₇ Copper sulphate (0.4%) + Manganese sulphate (0.5%) + Zinc sulphate (0.25%) followed by T₃ Borax (0.25%) while the

minimum (31.56 g) fruit weight was recorded with control (water spray). Treatments T₆ Copper sulphate (0.4%) + Zinc sulphate (0.25%) + borax (0.25%), T₄ Copper sulphate (0.4%), T₂ Zinc sulphate (0.25%) were found at par with T₇. The lowest stone weight (1.86 g) was found spray of Copper sulphate (0.4%) + Zinc sulphate (0.25%) + Borax (0.25%).

It concluded that the foliar feeding of CuSO₄ (0.4%) + MnSO₄ (0.5%) + ZnSO₄ (0.4%) is best for improving physico-chemical attributes of aonla twice during mid-May and mid-July, can be advocated to aonla growers for better quality fruits.

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