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Effect of foliar feeding of micro-nutrients on yield and quality of Aonla (*Emblica officinalis* Gaertn) cv. Chakaiya

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Abstract
The present investigation carried out to know the effect of foliar feeding of micro-nutrients on yield quality of Anola (*Emblica officinalis* Gaertn) cultivar Chakaiya. The experiment was conducted during (2012-13) at Main Experiment Station, horticulture, A.N.D.U.A.T., Kumarganj, Faizabad. The present investigation revealed that the maximum pulp: stone ratio (13.64:1) and volume (31.45 cm3) was observed due to foliar spray of ZnSO4 (0.5%) followed by K_2O 2.0% (13.18:1 and31.10 cm3 respectively) as compared with other treatments. While, minimum pulp: stone ratio was recorded in control. The maximum volume 31.45 cm3 was recorded in $ZnSO_4$ (0.5%), followed by in K_2O (2.0%). While, minimum volume 27.97 cm3 was observed in control. The maximum TSS content in fruit pulp (8.86%) was observed due to foliar spray of ZnSO4 (0.5%) followed by 8.80% in K_2O (2.0%) as compared with other treatments.

Keywords: Anola, foliar feeding, micro-nutrients

Introduction
The Aonla (*Emblica officinalis* Gaertn) is one of the most important indigenous fruit 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 (Morten, 1964) [19], which is grown in India since ancient times due to its religious, nutritional and therapeutic values. It is also recognized as a 'Amritphal' and 'Wonder drug' for its significance to health, wealth and vitality. Naturally growing aonla has been reported from Cylon, Cuba, Puetro, Fico, Hawaii, Florida, Iran, Iraq, Java, West Indies, Trindad, Pakistan Malaya, China. It is the second richest source of vitamin -C (500 mg/100 g pulp) among the fruits after Barbados cherry and rich in pectin, iron, calcium, and phosphorus. Among the Sub-tropical arid fruits, aonla has vast potential and wider adaptability to grow under variable range of soils and agro-edaphic conditions Chakaiya' / 'Chakala' is the old popular variety and widely adopted by the aonla growers. This variety covers the maximum cultivated areas in eastern parts of Uttar Pradesh due to its high bearing potential when other commercial varieties were not identified.
The role of micro-nutrients for improving the growth and development, fruit set, control of fruit drop, fruit maturation, fruit quality and overcoming the physiological and nutritional disorders have been well established in number of tropical, sub-tropical and temperate fruit crops (Singh *et al.*, 2007) [15]. However, it has been observed that the physiological, biochemical and biological activities in plant systems are highly influenced due to interaction of micro-nutrients and plant growth regulators. Among, the foliar application of different levels of nutrients *viz*., urea, potassium, iron, magnesium zinc, copper, boron etc, have been found more effective in improving the flowering, fruit sets, fruit size, fruit yield and fruit quality in number of fruit crops.

Materials and Methods
The experimental site was located at Main Experiment Station, Department of Fruit Science, College of Horticulture & Forestry, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.). The eight treatment *viz* 0.5% $ZnSO_4$ (T_1), 0.5% $CuSO_4$ (T_2), 0.5% Borax (T_3), 0.5% $FeSO_4$ (T_4), 0.5% $MgSO_4$ (T_5), 0.2% Urea (T_6), 0.2% K_2O (T_7) and Control (T_0) of different concentrations were taken spray were done at month of April and July. The experiment was lab reg. with eight treatment in randomized block design and replication the observation recorded.

Statistical analyses of the experimental data were recorded during the experimentation period as per treatments using the Statistical Methods.

Result and Discussion

Data pertaining to percent fruit drop recorded in due to foliar spray of nutrients at different stages of fruit development, clearly indicate that there were significant variations in percent fruit drop and minimum percent of fruit drop was recorded 75.40 percent in treatment $ZnSO_4$ (0.5%) followed by 76.90 percent in treatment K_2O (2.0%). However, the maximum percent fruit drop, was observed (81.90%) in control. The present findings are also in accordance to the observations recorded Singh and Vastistha (1997) [14] in ber cv. Seb, Rani and Brahmachari (2001) [11] in litchi cv. Purbi, Singh *et al.* (2012) [16] in aonla cv. Banarasi, Modi *et al.* (2012) [10] in papaya cv. Madhu Bindu.

A perusal of data recorded on percent fruit retention shown in reveal that there was significant response of foliar application of nutrients on better fruit retention. The maximum percent of fruit retention was recorded with foliar spray of nutrients $ZnSO_4$ (0.5%) followed by K_2O (2.0%). It is evident from the results that there was high association of heavy fruit drop with poor fruit retention and low fruit drop with high fruit retention due to influence of optimum/high levels of nutrients supplemented through foliar feeding. The present finding is in conformity with observations recorded by Singh *et al.* (1994) [13] in mango, Singh and Vastistha (1997) [14] in ber cv. Seb, in ber cv. Umran, Singh *et al.* (2007) [15] in aonla cv. N.A. 10, Shamshad *et al.* (2009) [12] in aonla cv. Narendra Aonla- 6, Kumar and Shukla (2010) [7] ber cv. Gola.

The foliar spray of nutrients has shown significant effect on increase in fruit yield. The highest fruit yield (101.60 kg/tree) was obtained due to spraying of $ZnSO_4$ (0.5%) followed by 87.90 kg/tree in K_2O (2.0%), as compared with other treatments while, minimum fruit yield was obtained in untreated trees. It is clear from the present findings that the yield attributing characters in aonla *viz.*, Percent fruit set, fruit retention, fruit size, fruit weight and pulp weight were significantly influenced by nutritional levels of trees, which were supplemented through foliar supplication of nutrients. The present finding is in conformity with the observations recorded in citrus cv. Blood Red, Kumar *et al.* (2004) [6] in litchi cv. Dehradun, Dutta and Banik (2007) [3] on guava cv. Sardar, Singh *et al.* (2009) [20] on aonla, Modi *et al.* (2012) [10] on papaya (*Carica papaya* L.) cv. Madhu Bindu and Singh *et al.* (2012) [16] on aonla cv. Banarasi.

The development of fruits size in respect to polar fruit length and fruit breadth is highly associated with the nutrients and other metabolites. Data pertaining to fruit length showed significant variation due to foliar application of various nutrients. The maximum fruit length (3.30%) was recorded with foliar spray of $ZnSO_4$ (0.5%) as compared with other treatments. However, significant differences were recorded in fruit breadth due to foliar spray of different treatments. The maximum fruit breadth (3.70 cm) was recorded with foliar spray of $ZnSO_4$ (0.5%); whereas, minimum fruit length and fruit breadth were recorded in control.

The increase in fruit size of aonla might be due to foliar application of various nutrients with zinc, borax potash, urea, copper zinc, ferrous and magnesium, which showed effect on size of the fruit. However, the beneficial effect of foliar application of zinc sulphate was found better. The observations recorded in present investigation are also in accordance to studies undertaken by Rani and Brahmachari (2001) [11] in litchi cv. Purbi, Kumar *et al.* (2004) [6] in litchi cv. Dehradun, Meena *et al.* (2005) [9] on guava cv. Sardar, Ghosh (2009) [5] in aonla cv. NA-10, Singh *et al.* (2009) [20] in aonla and Bhowmick *et al.* (2012) [2] in mango cv. Amrapali. The similar results have also been reported by Dutta *et al.* (2011) [4] in mango cultivar Dashehari.

It is also evident from the data recorded on fruit weight due to foliar application of different treatments that there was significant variation in average fruit weight, which ranged from 28.75 to 32.90 g. The maximum average fruit weight (32.90 g) was recorded due to foliar application of $ZnSO_4$ (0.5%) followed by 32.90 g in K_2O (2.0%) and minimum fruit weight (28.75 g) was in control. The increase in size of fruit is associated with the levels of nutrients, which play an important role in development of ovary in to fruits as zinc promotes the auxin synthesis. Similar observations in respect fruit weight has also been recorded by Dutta *et al.* (2011) [4] on weight by potassium application in mango. Rani and Brahmachari (2001) [11] on litchi cv. Purbi, Meena *et al.* (2005) [9] on guava cv. Sardar, Animesh and Ghosh (2009) [5] in litchi cv. Bombai, Singh *et al.* (2009) [20] on phalsa, Bhowmick *et al.* (2012) [2] in mango cv. Amrapali and Shukla *et al.* (2011) [17] on aonla fruits 'Banarasi'.

Data pertaining to pulp: stone ratio as influenced by foliar application of differenotht treatments shown in Table 4.6 indicated that maximum pulp: stone ratio with foliar spray of $ZnSO_4$ (0.5%) followed by K_2O (2.0%). Similar response was also recorded in pulp: stone ratio due to different treatments in other fruits. It is evident from the present finding that the increase in pulp weight and pulp: stone ratio in developing fruits might be due to the acceleration in biochemical activities and accumulation of metabolites in plant parts due to optimum level of nutrients status of plants. The present observation is also in accordance to observations recorded by Meena *et al.* (2005) [9] in guava.

The increase in fruit volume of aonla might be due to foliar application of various nutrients with zinc, borax, potash, urea, copper, ferrous and magnesium, which showed effect on volume of the fruit. However, the better beneficial effects were found with foliar application of $ZnSO_4$ (0.5%) followed by K_2O (2.0%). The observations recorded in present investigation are also in accordance to studies undertaken by Rani and Brahmachari (2001) on litchi cv. Purbi, Kumar *et al.* 2004 [6] in litchi cv. Dehradun, Meena *et al.* (2005) [9] on guava cv. Sardar, Ghosh (2009) [5] in aonla cv. NA-10, Singh *et al.* (2009) [20] on phalsa fruit and Bhowmick *et al.* (2012) [2] in mango cv. Amrapali.

Chemical characters of fruit

The observations recorded on fruit quality *viz.*, TSS, acidity, vitamin-C, reducing sugars, non-reducing sugar and total sugars due to foliar spray of nutrients have been presented in Tables 3.

A perusal of data recorded on total soluble solids (TSS) due to influence of different treatments clearly indicated that there were significant differences in TSS content. The highest TSS (8.86%) was observed with spraying of $ZnSO_4$ (0.5%) followed by 8.80% in K_2O (2.0%). and lowest in control (8.15%). The increase in TSS content of aonla fruit might be due to accumulation of higher level of water soluble compounds *viz*, total sugars, vitamins, minerals, which were

synthesized, translocated and accumulated due to chemical changes during the fruit development and maturity of fruits. The water soluble compounds in developing fruits might increase due to various levels of nutrients. The present findings are also agreement with the observations recorded in other fruits by Rani and Brahmachari (2001) [11] on litchi cv. Purbi, Meena *et al*. (2005) [9] on guava cv. Sardar, Animesh and Ghosh (2009) [5] in litchi cv. Bombai, Singh *et al*. (2009) [20] on phalsa fruit and Shukla *et al.* (2011) [17] on aonla fruits 'Banarasi'.

Data pertaining to acidity content (Citric acid) in aonla fruit due to influence of different treatments indicated that minimum acidity content was observed with $ZnSO_4$ (0.5%) followed by K_2O (2.0%). The maximum acidity (2.40%) was in control. It is apparent from the results that the reduction in acidity content due to increase the level of nutrients, sugars and other chemical compounds, which might have shown beneficial role in improving the quality of fruits by reducing the acidity content. The present observations are in conformity with findings of by Rani and Brahmachari (2001) [11] on litchi cv. Purbi, Meena *et al*. (2005) [9] on guava cv. Sardar, Animesh and Ghosh (2009) [5] in litchi cv. Bombai, Singh *et al*. (2009) [20] on phalsa fruit and Shukla *et al.* (2011) [17] on aonla fruits cv. 'Banarasi'.

Vitamin-C (Ascorbic acid) content in aonla fruit is one of the prime active chemical compounds, which is significantly influenced due to endogenous nutritional status of plants and environmental factors. The observations recorded on vitamin-C content in aonla cv. Chakaiya were significantly influenced by foliar application of different treatments. The maximum Vitamin-C content was observed with foliar spray of $ZnSO_4$ (0.5%) as compared to other treatments and lowest in control. It is evident from the result that the beneficial effect of nutrients might be due to stimulatory response of efficient synthesis and translocation of Vitamin-C content to the developing fruits. The present findings is also in conformity with the observations recorded by Rani and Brahmachari (2001) [11] on litchi cv. Purbi, Meena *et al*. (2005) in guava cv. Sardar, Animesh and Ghosh (2009) [5] in litchi cv. Bombai, Singh *et al*. (2009) [20] on phalsa fruit and Shukla *et al.* (2011) [17] in aonla cv.'Banarasi'.

A perusal of observations recorded on percent reducing, non-reducing and total sugar contents reveal that there was significant response to the foliar application of nutrients to increase the concentrations of reducing, non-reducing and total sugars as compared to control. The maximum reducing sugars, non-reducing sugars and total sugars were observed due to foliar spray of $ZnSO_4$ (0.5%) followed by K_2O (2.0%).

The reasons for increase in fruit quality, especially sugar content can be explained by the role of K in CHO synthesis, breakdown & translocation and synthesis of protein and neutralization of physiologically important organic acid (Trivedi and Nelson, 1966). It is evident from the present observations that the total sugars content in aonla fruit is very negligible being a non-climatic fruit, in which the synthesis of polysaccharides and their derivatives is not too much prominent due to presence of high amount of fiber content, phenolic compounds, Vitamin-C content and also lack of hydrolyzing enzymes, which inhibits the efficiency of photosynthesis. Thus, it is clear from the result that the sugars content is aonla is not much more significant chemical compounds, and which is also not much influenced by foliar application of nutrients. Similar observations were also recorded Rani and Brahmachari (2001) on litchi cv. Purbi, Meena *et al*. (2005) [9] on guava cv. Sardar, Animesh and Ghosh (2009) [1] in litchi cv. Bombai, Singh *et al*. (2009) [20] on phalsa fruit and Shukla *et al.* (2011) [17] in cv. 'Banarasi'.

Table 1: Effect of foliar application of nutrient on fruit drop, Retention and yield of Aonla

Treatment	Fruit drop	Fruit Retention	Yield
To – Control (water spray)	81.90	18.10	71.80
T_1 - $ZnSO_4$ (0.5%)	75.40	24.60	101.60
T_2 - $CuSO_4$ (0.5%)	77.70	22.30	85.60
T_3 - Borax (0.5%)	78.60	21.40	78.90
T_4- $FeSO_4$ (0.5%)	78.80	21.20	77.60
T_5 - $MgSO_4$ (0.5%)	79.20	20.80	76.50
T_6 – Urea (2.0%)	77.80	22.20	84.70
T_7 K_2O (2.0%)	76.90	23.10	87.90
S. Em. ±	1.56	0.78	3.76
C D at 5%	4.75	2.36	11.39

Table 2: Effect of foliar application of nutrient on Physical characters of fruit of Aonla

Treatment	size (cm)		weight	Pulp stone ratio	Volume
	Length	Width			
To – Control (Water spray)	2.90	3.25	28.75	10.55	27.97
T_1 - $ZnSO_4$ (0.5%)	3.30	3.70	32.90	13.64	31.45
T_2 - $CuSO_4$ (0.5%)	3.05	3.40	30.80	12.51	30.05
T_3 - Borax (0.5%)	3.00	3.40	30.20	11.92	29.60
T_4- $FeSO_4$ (0.5%)	2.98	3.38	30.00	11.72	29.15
T_5 - $MgSO_4$ (0.5%)	2.95	3.35	29.60	11.40	28.70
T_6 – Urea (2.0%)	3.10	3.55	31.50	12.26	29.85
T_7 K_2O (2.0%)	3.20	3.62	32.00	13.18	31.10
S. Em. ±	0.07	0.08	0.46	0.39	0.61
C D at 5%	0.21	0.25	1.39	1.19	1.84

Table 3: Effect of foliar spray of nutrient on chemical characters of fruit a aonla.

Treatment	TSS (^{0}B)	Acidity (%)	Ascorbic acid (mg/100 g)	Reducing sugar (%)	Non-reducing sugar (%)	Total sugar (%)
To– Control (Water spray)	8.15	2.40	522.50	2.35	1.83	4.18
T_1 - $ZnSO_4$ (0.5%)	8.86	2.20	556.40	2.70	2.22	4.92
T_2 - $CuSO_4$ (0.5%)	8.70	2.28	540.60	2.58	2.12	4.70
T_3 - Borax (0.5%)	8.55	2.32	536.10	2.48	2.12	4.60
T_4 - $FeSO_4$ (0.5%)	8.50	2.35	534.40	2.45	2.10	4.55
T_5 - $MgSO_4$ (0.5%)	8.45	2.36	531.80	2.42	1.08	4.50
T_6 – Urea (2.0%)	8.65	2.30	538.60	2.55	2.13	4.68
T_7 K_2O (2.0%)	8.80	2.25	547.70	2.65	2.15	4.80
S. Em.±	0.09	0.037	5.10	0.03	0.04	0.06
C D at 5%	0.28	0.113	15.47	0.10	0.12	0.17

References

1. Animesh Sarkar, Bikash Ghosh. Effect of foliar application of micro-nutrients on retention, yield and quality of fruit in litchi cv. Bombai Environment and Ecology, 2009, 27(1).
2. Bhowmick N, Banik BC, Hasan MA, Ghosh B. Response of pre-harvest foliar application of zinc and boron on mango cv. Amrapali under New Alluvial Zone of West Bengal. Indian Journal of Horticulture. 2012;69(3):428-431.
3. Dutta P, Banik AK. Effect of foliar feeding of nutrients and plant growth regulators on physico-chemical quality of Sardar guava grown in red and lateraitic tracts of West Bengal. Acta Horticulture. 2007;735:407-411.
4. Dutta P, Ahamad B, Kundu S. Effect of different sources of potassium on yield, quality and leaf nutrient of mango in West Bengal. Bette Crops. 2011;5(1):16-18.
5. 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. Journal of Horticultural Sciences. 2009;4(2):164-166.
6. Kumar S, Verma KK. Effect of micro-nutrients and NAA on yield and quality of litchi cv. Deharadun fruits. Abstr. In Proc. International Seminar on Recent Trend in Hi-tech Hort. and PHI. Organized by CSAUA&T., Kanpur from; c2004 Feb 4-6, 193.
7. Kumar Sunil, Shukla AK. Improvement of old ber cv. Gola orchard through budding and micro-nutrients management. Indian Journal of Horticulture. 2010;67(3):322-327.
8. Mansour NM, Sied ZAHEl. Effect of Zinc sulphate on fruiting and yield of guava trees. Agril. Research Review. 1981;89(3):119-135.
9. Meena RP, Mohammed S, Lakhawat SS. Effect of foliar application of urea and zinc sulphate on fruit quality and yield of pruned guava trees (*Psidium guajava* L.) cv. 'Sardar' under high density planting system. Udyanika. 2005;11(2):90-93.
10. Modi PK, Varma LR, Bhalerao PP, Verma P, Khade A. Micronutrient spray effects on growth, yield and quality of papaya (*Carica papaya* L.) cv. Madhu Bindu. Madras Agricultural Journal. 2012;99(7/9):500-502.
11. Rani R, Brahmachari VS. Effect of foliar application of calcium, zinc and boron on cracking and physico-chemical composition of litchi. Orissa Journal of Horticulture. 2001;29(1):50-54.
12. Shamashad Khan, Singh HK, Vishwanath, Bhanu Pratap. Impact of foliar application of micronutrients and thiourea on growth, fruit yield and quality of aonla (*Emblica officinalis* Gaertn) cv. Narendra Aonla-6. Annals of Horticulture. 2009;2(1):83-85.
13. Singh JN, Singh DK, Chakravarty D. Effect of Urea and NAA on fruit retention and physio-chemical compositions of mango (*Mangifera indica* L.) cv. Langra. The Orissa J. Hort. 1994;22(1-2):26-30.
14. Singh RS, Vashistha BB. Effect of foliar spray of nutrients on fruit drop, yield and quality of ber cv. Seb. Haryana J. Hort. Sci. 1997;26(1-2):20-24.
15. Singh JK, Prasad J, Singh HK. Effect of micro-nutrients and plant growth regulators on yield and physico-chemical characteristics of aonla fruits in cv. Narendra Aonla-10. Indian Journal of Horticulture. 2007;64:(2):216-218.
16. 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.
17. Shukla HS, Kumar V, Tripathi VK. Effect of gibberellic acid and boron on development and quality of aonla fruits 'Banarasi'. Acta Horticulturae. 2011;890:375-380.
18. Trivedi SL, Nelson WN. Soil fertility and fertilizers. Macmillan Co. London; c1966. p. 81.
19. Morten N. La fable antique. Les grands fabulistes, Nyt nordisk forlag, Københaun; c1964.
20. Singh B, Sharma DK, Kumar R, Gupta A. Controlled release of the fungicide thiram from starch–alginate–clay based formulation. Applied Clay Science. 2009 Jun 1;45(1-2):76-82.