ISAH INDIAN JOURNAL OF ARID HORTICULTURE
2019, Vol. 1 (1):50-52

Effect of zinc sulphate, ferrous sulphate and borax on yield and quality of aonla (*Emblica officinalis* Gaertn.) cv. NA-7

Bhanu Pratap, H.K.Singh, Abhinav Kumar, N. L. Sharma,
Sachi Gupta, Sneha Singh and Harendra
AICRP Arid Zone Fruits, Department of Fruit Science
Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya
(Received: 14.05.2019; Accepted: 22.07.2019)

Abstract

The investigation was taken up at MES Horticulture, NDUAT, Ayodhya to improving the fruit yield and enhancing the fruit quality through foliar application of micronutrients in aonla cultivar NA-7. The study revealed that the foliar spray of micronutrient combination of % $ZnSO_4$0.5 % + $FeSO_4$ 0.5%+ Borax0.25 %) significantly increased yield (6.93 tonnes/ha). The yield was almost double as compared to control in the said combination of micronutrients as a result higher benefit cost ratio (3.60) was recorded. Further, the quality parameters of fruits such as higher total sugar, reducing sugar and non-reducing sugar content of fruits was significantly improved without reducing the vitamin C (483.71 mg/100 g) with the above said combination of nutrients. Hence, the micronutrient combination of $ZnSO_4$ 0.5 % + $FeSO_4$ 0.5 % + Borax 0.2 5% holds immense potential as a foliar spray in arresting fruit drop and doubling up the yield in aonla.

Keywords: Aonla, zinc sulphate, borax, foliar spray micronutrient

Introduction

Aonla (*Emblica officinalis* Gaertn.) is an important fruit crop of commercial significance. It is quite hardy, prolific bearer and remunerative even without much care. It belongs to the family Euphorbiaceae. Aonla is an important fruit of future due to its high medicinal and nutritional value. Aonla is the richest source of vitamin "C" among all fruits after Barbados cherry. The aonla fruit contains about three times more protein and 160 times more vitamin "C" as compared to apple. Its fruit is valued as diuretic, laxative, antibiotic and cooling refrigerant. It is well known that calcium play an important role in maintaining quality of fruits and vegetable and calcium treatment helps to retain fruit firmness, increase vitamin C content, decrease storage breakdown and rotting and also decrease browning in fruits. The crop is been cultivated in Sri Lanka, Malaysia and China, etc. In India, it is being cultivated in an area of about 93,000 ha with an annual production of 1077000 MT (Anon., 2017), particularly in the in the salt affected districts of Uttar Pradesh, arid and semiarid parts of Maharashtra, Gujarat, Rajasthan, Karnataka etc,. It is a rich source of vitamin C (500-600 mg/100g) among fruits and ranks second after Barbados cherry (Asengo, 1953).

Aonla growers are experiencing the problem of reduced yield and sometimes reduced quality due to necrosis and fruit drop which is associated with deficiency of boron and other micronutrients. The micronutrients like zinc sulphate and Ferrous sulphate and iron play a vital role in fruit growth and development and their application is found effective to solve these problems. Keeping this in mind the present study was conducted to study the effect of $ZnSO_4$, $FeSO_4$ and Borax on Yield and Quality of Aonla (*Emblica officinalis* Gaertn.) cv. NA-7 at the Main Experiment Station, Horticulture (MES), Narendra Deva University of Agriculture and Technology Kumarganj, Ayodhya, U.P.

Materials and Methods

Twenty year old uniform plants of aonla *cv*. NA-7 were used which were spaced at 6m x 6m (277 plants/ha). Fertilizers were applied uniformly as per the recommendations; FYM 25.00 kg/plant (2.5 tonnes/ha) + 75:50:50 g NPK/ plant. Treatment included use of three different nutrients at different combinations; T1 (Control, water spray), T2 ($ZnSO_4$0.5 %), T3 ($FeSO_4$ 0.5 %), T4 (Borax 0.25%), T5 ($ZnSO_4$0.5 % + $FeSO_4$ 0.5 %), T6 ($ZnSO_4$0.5 % + Borax 0.25%), T7 ($FeSO_4$ 0.5 %+ Borax 0.25%), T8 ($ZnSO_4$0.5 % + $FeSO_4$ 0.5 % +Borax 0.25%). Two sprays were taken; one is at the time of flushing and second at sixty days after flushing which coincides with flowering.

The total cumulative yield per plant was recorded with a weighing machine and expressed in kilograms and the yield per hectare. For determination of fruit chemical parameters of fruit viz., titrable acidity (%), total soluble solids (TSS in ^{o}Bix), sugars (total, reducing and non-reducing sugars in per cent), ascorbic acid (mg/100 g pulp) content, five healthy fruits from each tree at full maturity stage. Hand refractometer was used for determination of total soluble solids, simple acid- alkali titration method was used for titrable acidity (Ranganna, 1977). Sugars in fruit juice and ascorbic acid (2, 6-dichlorophenol indophenols visual titration method) contents were determined as described by Ranganna (1986).

The experiment was laid out in a completely

randomized block design (RBD) with three replications. Three plants for each treatment were sampled for plant growth, reproductive and yield components. Five fruits were randomly selected for evaluating fruit physical and chemical features. The data were analysed in a completely randomized block design using analysis of variance (ANOVA).

Results and Discussion

The foliar application of micronutrients had significant influence on yield of aonla. The highest fruit yield (24.96 kg tree^{-1}) was recorded with the combined application of $ZnSO_4$ 0.5 %, $FeSO_4$ 0.5 % and Borax 0.25 % (T8). The increase in yield might be due to direct or indirect involvement of micronutrients in photosynthesis, fruit setting, retention, reduction in drop as well as growth and development of fruits caused by foliar sprays of zinc, iron and boron. The application of zinc and boron might have caused rapid synthesis of protein and translocation of carbohydrate which ultimately led to increase in fruit weight which is directly correlated with total yield (Singh *et al.,* 2012). Similar results have been reported in aonla (Ram *et al.,* 1977) and in litchi (Babu and Singh, 2001).
The treatment combination of $ZnSO_4$ 0.5 %, $FeSO_4$ 0.5 % and Borax 0.25 % (T8) resulted in highest cost benefit ratio (3.60) when compared to control (2.51) and other micronutrient combinations (Table 1). The highest cost benefit ratio obtained may be attributed to reduction in fruit drop and nearly two fold increase in the overall yield per plant. The earlier reports on guava (Waskela *et al.,* 2013) also revealed higher cost benefit ratio of 5.02, consequent to the combined application of ZnSO4, FeSO4 and boron.

TSS, titrable acidity and TSS: acid ratios were found statistically non- significant, whereas the higher ascorbic acid content (486.88 mg/100g) was recorded from nutrient combination of zinc 0.5 % and iron 0.5 % (T5) (Table 2). The vitamin C of fruits was appreciably influenced by synthesis of catalytic enzymes stimulated by zinc application. The increase in ascorbic acid might be due to catalytic influence of micronutrients on its bio-synthesis from its precursor glucose 6- phosphate or inhibition of its conversion to dehydroxy ascorbic acid by enzyme ascorbic acid oxidase or both. The present observations are in close agreement with the reports of Pandey *et al.,* (1998) in guava. The highest total sugars (4.94 %) were recorded in micronutrient combination of $ZnSO_4$ 0.5 %, $FeSO_4$ 0.5 % and Borax 0.25 % (T8) (Table 3).

The increase in total sugars of fruit was may be due to significant action of micronutrients on translocation of carbohydrates and photosynthates. This is in conformity with the results of Singh *et al.,* (2002) and Singh *et al.,* (2012), who reported that increase in sugars fraction by the foliar feeding of zinc and boron might be due to their involvement in photosynthesis of metabolites and rapid translocation of sugars from other part of the plants to developing fruits.

The per cent increase in reducing sugars was highest with micronutrient combination of $ZnSO_4$ 0.5 %, $FeSO_4$ 0.5 % and Borax 0.25 % (T8). Increase in reducing sugars have direct link with beneficial effect of micronutrients on conversion of polysaccharides to simple sugars. The similar results were also found from the experiments of Kumar and Shukla (2010), who reported direct and indirect effects of micronutrients on quality of fruits. On the other hand, the highest non reducing sugar was recorded with combined application of $ZnSO_4$ 0.5 % and Borax 0.25 % (T6). The effect of these micronutrients on per cent non reducing sugars was mainly attributed to increased translocation of polysaccharides in mature fruits. These results are in close conformity with the findings of Singh *et al.,* (2012).

This may be concluded from the above highlighted experimental findings of the present investigation due to effect of foliar spray of nutrients revealed that, micronutrient combinations of $ZnSO_4$ 0.5 % + $FeSO_4$ 0.5 % + Borax 0.25 % (T8) was found to be most effective for overall increment of yield, highest cost benefit ratio and quality attributes. The fruit yield was almost double as compared to control. Hence, the above said nutrient combination holds immense potential as a foliar spray for doubling up the yield and to improve quality in aonla.

Table 1. Effect of $ZnSO_4$, $FeSO_4$ and Borax on fruit yield and benefit: cost ratio of aonla cv. NA-7

Treatments	Yield (kg. tree^{-1})	Yield (tonnes ha^{-1})	B: C ratio
T1	14.92	4.11	2.51
T2	18.57	5.12	3.04
T3	15.95	4.43	2.38
T4	18.27	5.04	2.97
T5	19.62	5.41	2.86
T6	22.22	6.12	3.52
T7	21.06	5.83	3.06
T8	24.96	6.93	3.60
S. Em.	1.66	0.46	-
CD at 5%	5.04	1.40	-

Table 2. Effect of $ZnSO_4$, $FeSO_4$ and Borax on quality of fruits of aonla cv. NA-7

Treatments	TSS (^oB)	Titrable acidity (%)	TSS : Acid ratio	Vitamin C (mg/100g)
T1	8.38	1.03	8.96	476.48
T2	8.41	1.07	7.99	482.78
T3	8.97	1.02	9.71	485.03
T4	8.58	1.38	6.52	483.51
T5	8.76	1.15	8.87	486.88
T6	8.61	1.22	7.33	482.65
T7	8.51	1.57	5.47	478.17
T8	8.23	1.20	7.94	484.71
S. Em.±	0.35	0.25	1.62	1.47
CD at 5%	NS	NS	NS	4.45

Table 3. Effect of $ZnSO_4$, $FeSO_4$ and Borax on quality of fruits of aonla cv. NA-7

Treatment	Total sugar (%)	Reducing sugars (%)	Non reducing sugars (%)	Sugar: Acid ratio	Storage life (Days) (at room temperature
T1	3.76	2.31	1.47	4.05	5.33
T2	4.30	2.30	1.99	3.96	7.00
T3	3.94	2.29	1.66	4.22	6.67
T4	4.41	2.37	2.03	3.31	6.33
T5	3.94	2.51	1.42	4.04	5.67
T6	4.85	2.69	2.17	4.16	7.67
T7	4.41	2.72	1.70	2.85	6.67
T8	4.94	3.01	1.93	4.91	7.33
S. Em. ±	0.23	0.06	0.23	-	-
CD at 5%	0.68	0.18	0.70	NS	NS

References

Anonymous, 2017, NHB-Database-2017, nhb.gov.in/area production/html.

Asengo, C. F., 1953, The story of West Indian Cherry, Bull. *Del collegio, de quimicosde, Puret Rico.,*10: 8-11.

Kumar, S. and Shukla, B. A., 2010, Improvement of old ber *cv.* Gola orchard through bunding and micronutrients management. *Indian J. Hort*., 67 (3): 322-327.

Meena, D., Tiwari, R. and Singh, O.P., 2014, Effect of nutrient spray on growth, fruit yield and quality of aonla, *Annals of Plant and Soil Research*, 16(3): 242- 245.

Pandey, D. K., Pathak, R. A. and Pathak, R. K., 1998, Studies on the foliar application of nutrients and plant growth regulators in Sardar Guava I- Effect on yield and fruit quality. *Indian J. Hortic*., 45 (3-4): 197-202.

Panwar, R. D., Saini, R. S., Kaushik, R. A. and Yamdagni, R., 1995, Effect of micronutrients on fruit retention, yield and quality of aonla *cv.* Banarasi under rainfed condition. *Haryana J. Hortic. Sci*., 22 (1-2): 250-251.

Ranganna, S., 1977, Manual of analysis of fruits and vegetables products. Tata Mcgrow Hill Pub. Co. Ltd., New Delhi. p. 255.

Ranganna, S., 1986, Handbook of analysis and quality control for fruit and vegetable products. Second edn. Tata McGraw-Hill Pub. Co. Ltd., New Delhi, India

Singh, H. K., Srivastava, A. K., Dwivedi, R. and Kumar, P., 2002, Effect of foliar feeding of micro-nutrients on plant growth, fruit quality, yield and internal fruit necrosis of aonla (*Emblica officinalis* Gaertn.) *cv.* Francis. *Prog. Hort*., 33 (1): 80-83.

Singh, J. K., Prasad, J. and Singh, H. K., 2007, Effect of micro-nutrients and plant growth regulators on yield and physic-chemical characteristics of aonla fruits in *cv.* Narendra Aonla-10. *Indian J, Hort*., 64 (2): 216-218.

Singh, P. C., Gangwar, R. S. and Singh, V. K., 2012, Effect of micronutrients spray on fruit drop, fruit quality and yield of aonla *cv.* Banarasi, *Hort. Flora Research Spectrum*, 1(1): 73-76.

Waskela, R. S., Kanpure, R. N., Kumawat, B. R. and Kachouli, B. K., 2013, Effect of foliar spray of micronutrients on growth, yield and quality of guava (*Psidium guajava* L.) *cv.* Dharidar. *International Journal of Agricultural Sciences*, 9 (2): 551-556.