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# EFFECT OF NUTRIENT SPRAY ON GROWTH, FRUIT YIELD AND QUALITY OF AONLA

**DINESH MEENA, RAJESH TIWARI* AND O.P. SINGH****

*Department of Fruit Science, RVSKVV, Campus College of Horticulture, Mandsaur - 458 001 (M.P)*
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## ABSTRACT

*An experiment was conducted on six year old aonla tree cv. NA-7 at Mandsaur to study the effect of nutrients spray on growth, yield and quality of aonla. The plant height increment (0.95 m), Canopy spread E-W and N-S increment (0.89 m and 0.86 m), canopy height increment (0.93 m), fruit volume (44.10 ml), fruit length (4.20 cm), fruit diameter (4.46 cm), pulp thickness (1.41 cm), reducing sugar (3.56%), non reducing sugar (2.99%), juice (78.22%), fruit weight (45.20 g), yield per tree (42.70 kg) were recorded highest with the combined spray of 0.6% calcium nitrate + 0.4% borax + 0.8% zinc sulphate. Treatment having 0.3% calcium nitrate + 0.2% borax + 0.4% zinc sulphate proved the second best in respect of these parameters. Minimum values of these characters were recordedwith water storage.*

**Key word**: Calcium, boron, zinc, aonla, quality, yield.

## INTRODUCTION

Aonla (*Emblica officinalis* Gaertn syn. *Phyllanthus emblica* L.) 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 an anti-ascorbic, 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. Boron is important for ovule development, pollen tube growth and fruit set. Boron is a constituent of cell membrane and essential for cell division. It acts as a regulator of potassium/calcium ratio in the plant and helps in nitrogen absorption and translocation of sugar in plant. Boron increases nitrogen availability in plant. Zinc is an essential trace element for plants, being involved in many enzymatic reactions and is necessary for good growth and development. Zinc is also involved in regulating the protein and carbohydrate metabolism. 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. Obviously, it is an ideal way of evading the problems of nutrient availability. This method is highly helpful for the correction of element deficiencies to restore disrupted nutrient supply, to overcome stress factors limiting their availability and it plays a very important role in improving fruit set, productivity and quality of fruits and recovery of nutritional and physiological disorder in fruit trees. Various experiments have been conducted earlier on foliar spray of micro-nutrients in different fruit crops and have shown significant response to improve yield and quality of fruits (Shukla, 2011). Keeping in view the above aspects, the present experiment was initiated to study the effect of nutrients spray on aonla.

## MATERIALS AND METHOD

The experiment was conducted on six year old cv. NA-7 aonla tree at the Department of Fruit Science, K.N.K. College of Horticulture, Mandsaur during 2012-13. The experiment was laid out in randomized block design with three replications. The treatment consisted eleven foliar application of calcium as calcium nitrate, boron as borax and zinc as zinc sulphate. These were: $T_0$ control (water spray), $T_1$ (calcium nitrate 0.3%), $T_2$ (calcium nitrate 0.6%), $T_3$ (borax 0.2%), $T_4$ (borax 0.4%), $T_5$ (zinc sulphate 0.4%), $T_6$ (zinc sulphate 0.8%), $T_7$ (calcium nitrate 0.6% + borax 0.4%), $T_8$ (calcium nitrate 0.6% + zinc sulphate 0.8%), $T_9$ (calcium nitrate 0.3% + borax 0.2% + zinc sulphate 0.4%), $T_{10}$ (calcium nitrate 0.6% + borax 0.4% + zinc sulphate 0.8%). The treatments were imposed at four times 45 days' intervals after flowering. For recording various growth parameters of fruit viz. plant height, canopy spread, canopy height. The height of the plant and canopy spread was measured with the help of measuring device at the time of foliar application and at harvest and calculation of increase in plant height and canopy spread during the experimental was calculated. Fruit

*Correspondent authors e-mail: rt_jnkvv@yahoo.com
**Department of Plant Physiology, College of Horticulture, Mandsaur

length and diameter were noted using the vernier caliper, volume of fruit was recorded by water displacement method and weight of fruit was recorded using electronic weigh balance. While reproductive parameters were calculated by following formulas:

Fruit setting (%) = (Number of set fruits/ Number of flowers) x100

$$\text{Fruit drop (\%)} = \frac{\text{(Total no. of fruit set - Total no. of fruits at harvest time)}}{\text{Total number of fruit set}} \times 100$$

Fruit retention (%) = Number of fruits at harvest/ initial number of fruit set x100

For determination of chemical parameters of fruit viz. acidity, total soluble solids (TSS), sugars (total, reducing and non-reducing sugars), ascorbic acid and pectin content, four healthy fruits were selected randomly from each tree at full maturity stage. Hand refractometer was used for determination of T.S.S. in $^0$Brix. Acidity was estimated by simple acid–alkali titration method (A.O.A.C., 1970). Sugars in fruit juice were estimated by the method as suggested by Nelson (1944). Assay method of ascorbic acid was followed given by Ranganna (1977).

**RESULTS AND DISCUSSION**

Observations on the effect of different treatments on morphological and reproductive parameters were recorded to assess the growth behaviour under uniform management situation (Table 1). The individual spray of calcium nitrate, borax and zinc sulphate increased the morphological and reproductive parameters significantly over control. But maximum values of plant height (0.95 m), canopy spread in N-S direction (0.86 m) and in E-W direction (0.89 m) were found with spray of 0.6% calcium nitrate + 0.4% borax + 0.8% zinc sulphate followed by 0.3% calcium nitrate + 0.2% borax + 0.4% zinc sulphate treatment . The minimum fruit drop percentage (32.6%) and maximum fruit retention (67.4%) was also recorded with spray of 0.6% calcium nitrate + 0.4% borax + 0.8% zinc sulphate. The maximum fruit drop (79.2%) and minimum fruit retention (20.8%) were recorded under control. The increase in vegetative growth of plants might be due to stimulative effect of zinc because it is an essential element for chlorophyll formation which is directly related to photosynthetic activity of the plant (Khan *et al.*, 2009). Maximum fruit retention and minimum fruit drop might be due to calcium and boron being main constituent of cell wall (middle lamella) of plant cell in the form of calcium pectate which play an important role in strengthening of pedicel attached to proximal end of fruit resulted less fruit drop. Similarly reduction in fruit drop by spray of borax can be due to the indirect action of boron in auxin synthesis that delayed the formation of abscission layer during early stages of fruit development (Guardiola and Garcia, 2000). According to Krishnamoorthy (1992) fruit drop is an abscission phenomenon controlled by the inter play of hormones. Zinc application at higher level increased the foliar zinc content which ultimately encourages the endogenous production of auxin thereby reducing fruit drop. Zinc is required for the synthesis of tryptophan a precursor of auxin thus helps in reducing fruit drop.

Data (Table 2) indicated that maximum fruit volume (44.10 ml), fruit length (4.20 cm), fruit diameter (4.46 cm), pulp thickness (1.41 cm), at

Table 1: Effect of micronutrient sprays on morphological and reproductive parameters of aonla

| Treatment | Plant height (m) | Canopy spread (m) | | Canopy height (m) | Fruit drop (%) | Fruit retention (%) |
|---|---|---|---|---|---|---|
| | | E-W | N-S | | | |
| $T_0$ Water spray | 0.69 | 0.65 | 0.66 | 0.67 | 79.19 | 20.80 |
| $T_1$ 0.3% Calcium nitrate | 0.75 | 0.75 | 0.73 | 0.72 | 75.30 | 24.70 |
| $T_2$ 0.6% Calcium nitrate | 0.81 | 0.82 | 0.80 | 0.80 | 61.40 | 38.60 |
| $T_3$ 0.2% Borax | 0.77 | 0.75 | 0.73 | 0.75 | 74.70 | 25.30 |
| $T_4$ 0.4% Borax | 0.79 | 0.78 | 0.77 | 0.77 | 64.19 | 35.81 |
| $T_5$ 0.4% Zinc sulphate | 0.75 | 0.74 | 0.72 | 0.72 | 78.80 | 21.20 |
| $T_6$ 0.8% Zinc sulphate | 0.78 | 0.77 | 0.74 | 0.76 | 69.40 | 30.60 |
| $T_7$ 0.6% Calcium nitrate + 0.4% borax | 0.93 | 0.85 | 0.80 | 0.91 | 50.95 | 49.04 |
| $T_8$ 0.6% Calcium nitrate + 0.8% Zinc sulphate | 0.84 | 0.84 | 0.79 | 0.81 | 60.30 | 39.70 |
| $T_9$ 0.3% Calcium nitrate + 0.2% borax + 0.4% Zinc sulphate | 0.94 | 0.87 | 0.84 | 0.92 | 40.29 | 59.71 |
| $T_{10}$ 0.6% Calcium nitrate + 0.4% borax + 0.8% Zinc sulphate | 0.95 | 0.89 | 0.86 | 0.93 | 32.60 | 67.40 |
| C D (p=0.05) | 0.07 | 0.06 | 0.07 | 0.09 | 2.82 | 2.63 |

*(The data given for plant height, canopy spread and Canopy height are the increment during investigation period)*

harvest were recorded with foliar spray of 0.6% calcium nitrate + 0.4% borax + 0.8% zinc sulphate followed by 0.3% calcium nitrate + 0.2% borax + 0.4% zinc sulphate treatment. The increase in fruit size was due to accelerated rate of cell division and cell enlargement and more intercellular space with the application of higher concentration of growth substance. Boron plays an important role in accumulation of more photosynthates which is directly correlated with weight, size and volume of fruits. Increase in fruit size can be attributed to greater translocation of food materials from source to sink under the influence of micronutrients (Goswami *et al.* 2012) in guava. Increase in fruit size, weight and volume was might be due to foliar feeding of nutrients resulting in rapid cell division, cell elongation and development (Banic *et al.* 1997) in mango.

Table 2: Effect of micronutrient sprays on physical and yield parameters of aonla

| Treatment | Fruit volume (ml) | Fruit length (cm) | Fruit dia. (cm) | Pulp thickness (cm) | No. of fruits/ tree | Avg. fruit weight (g) | Yield/ tree (kg) |
|---|---|---|---|---|---|---|---|
| $T_0$ Water spray | 33.85 | 3.07 | 3.60 | 0.80 | 981.9 | 34.93 | 34.30 |
| $T_1$ 0.3% Calcium nitrate | 37.40 | 3.60 | 3.98 | 1.04 | 942.8 | 38.50 | 36.30 |
| $T_2$ 0.6% Calcium nitrate | 40.00 | 3.82 | 4.10 | 1.15 | 951.3 | 41.10 | 39.10 |
| $T_3$ 0.2% Borax | 37.82 | 3.65 | 4.06 | 1.10 | 959.5 | 38.98 | 37.40 |
| $T_4$ 0.4% Borax | 39.00 | 3.80 | 4.08 | 1.12 | 958.1 | 40.50 | 38.80 |
| $T_5$ 0.4% Zinc sulphate | 36.80 | 3.17 | 3.85 | 0.97 | 947.1 | 38.20 | 36.18 |
| $T_6$ 0.8% Zinc sulphate | 39.00 | 3.75 | 4.06 | 1.10 | 962.1 | 40.20 | 38.68 |
| $T_7$ 0.6% Calcium nitrate + 0.4% borax | 41.50 | 3.96 | 4.16 | 1.23 | 971.9 | 42.70 | 41.50 |
| $T_8$ 0.6% Calcium nitrate + 0.8% Zinc sulphate | 40.50 | 3.85 | 4.14 | 1.19 | 963.2 | 41.70 | 40.17 |
| $T_9$ 0.3% Calcium nitrate + 0.2% borax + 0.4% Zinc sulphate | 42.35 | 4.02 | 4.28 | 1.29 | 962.0 | 43.45 | 41.80 |
| $T_{10}$ 0.6% Calcium nitrate + 0.4% borax + 0.8% Zinc sulphate | 44.10 | 4.20 | 4.46 | 1.41 | 944.6 | 45.20 | 42.70 |
| C D (p=0.05) | 1.19 | 0.39 | 0.42 | 0.21 | 9.78 | 1.69 | 1.87 |

It is evident from Table 2 that the maximum fruit weight (45.20 g) and yield (42.70 kg) were recorded by the spray of 0.6% calcium nitrate + 0.4% borax + 0.8% zinc sulphate followed by 0.3% calcium nitrate + 0.2% borax + 0.4% zinc sulphate treatment and minimum in control (water spray). The application of zinc and boron might have caused rapid synthesis of protein and translocation of carbohydrate which ultimately lead to increase in fruit weight which is directly correlated with total yield (Singh *et al.*, 2012). Zinc plays an important role in auxin synthesis which is attributed to higher fruit retention and lower fruit drop and ultimately resulted into higher fruit yield.

Table 3: Effect of micronutrient sprays on quality of aonla fruits

| Treatment | Acidity (%) | TSS (%) | Red sugar (%) | Non-red. (%) | Ascorbic acid (mg/100 pulp) | Juice (%) | Fibre (%) |
|---|---|---|---|---|---|---|---|
| $T_0$ Water spray | 2.30 | 11.57 | 2.15 | 1.98 | 610.70 | 74.28 | 1.41 |
| $T_1$ 0.3% Calcium nitrate | 2.12 | 13.11 | 2.80 | 2.20 | 611.90 | 75.36 | 1.31 |
| $T_2$ 0.6% Calcium nitrate | 2.05 | 14.07 | 3.13 | 2.38 | 614.20 | 75.87 | 1.27 |
| $T_3$ 0.2% Borax | 2.10 | 13.25 | 2.85 | 2.21 | 611.98 | 75.50 | 1.30 |
| $T_4$ 0.4% Borax | 2.06 | 13.50 | 2.94 | 2.29 | 613.50 | 75.85 | 1.28 |
| $T_5$ 0.4% Zinc sulphate | 2.15 | 12.94 | 2.78 | 2.17 | 611.42 | 75.18 | 1.35 |
| $T_6$ 0.8% Zinc sulphate | 2.09 | 13.40 | 2.90 | 2.22 | 612.10 | 75.52 | 1.29 |
| $T_7$ 0.6% Calcium nitrate + 0.4% borax | 2.01 | 14.40 | 3.30 | 2.52 | 615.02 | 76.38 | 1.22 |
| $T_8$ 0.6% Calcium nitrate + 0.8% Zinc sulphate | 2.02 | 14.20 | 3.20 | 2.55 | 614.79 | 76.28 | 1.24 |
| $T_9$ 0.3% Calcium nitrate + 0.2% borax + 0.4% Zinc sulphate | 1.90 | 15.20 | 3.50 | 2.98 | 626.41 | 77.05 | 1.20 |
| $T_{10}$ 0.6% Calcium nitrate + 0.4% borax + 0.8% Zinc sulphate | 1.95 | 14.50 | 3.56 | 2.99 | 618.59 | 78.22 | 1.15 |
| C D (p=0.05) | 0.13 | 1.85 | 0.55 | 0.36 | 4.04 | 1.56 | 0.09 |

Maximum values of T.S.S. (15.20 0Brix), ascorbic acid content (626.41mg/100g pulp) and minimum acidity (1.90%) was noticed with combined foliar spray of 0.3% calcium nitrate + 0.2% borax + 0.4% zinc sulphate followed by 0.6% calcium nitrate + 0.4% borax + 0.8% zinc sulphate. The maximum values of reducing sugar (3.56%), non reducing sugar (2.99%), juice (78.22%) and minimum fibre (1.15%) were noticed by combined spray of 0.6% calcium nitrate + 0.4% borax + 0.8% zinc sulphate followed by 0.3% calcium nitrate + 0.2% borax + 0.4% zinc sulphate treatment. The 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 (Singh *et al.*, 2001 and Singh *et al.*, 2012). It may also be due to micronutrients which are known to impart direct and indirect effects on fruit quality (Kumar and Shukla, 2005). The acidity of fruits decreased with the application of zinc sulphate which might be due to more accumulation of total soluble solids. Zinc application also increased the ascorbic acid which seems to be due to increased growth and availability of more metabolites for ascorbic acid synthesis.

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