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INFLUENCE OF FOLIAR SPRAY OF NUTRIENT ON FRUITING AND YIELD OF AONLA (*EMBLICA OFFICINALIS* GAERTN.) CV. NA-6

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ABSTRACT
Aonla (*Emblica officinalis* Gaertn.) is an important fruit of 21st century because of its high nutritive and therapeutic value and it is widely distributed in Indian sub continent. There fore, the experiment was conducted on sixteen year old aonla fruits tree with seven foliar nutrient application treatments and replicated thrice at the Main Experiment Station, Department of Horticulture, Narendra Deva University of Agriculture & Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) during the year 2012-2013. The treatment combination of calcium nitrate (1%) + zinc sulphate (0.5%) + potassium sulphate (2%) established superior in esteem of maximum fruit retention (28.4%), length (4.3 cm), Breadth (4.4 cm), weight (44.3g), and fruit volume (41.4 cm^3) whereas the maximum fruit yield (61.8 kg) per tree with combined application of calcium nitrate (1%) + zinc sulphate (0.5%) + potassium sulphate (2%).

INTRODUCTION

Aonla *(Emblica officinalis* Gaertn) is one of the crucial minor fruit of India, which is also known as Indian gooseberry and amritphal. It comes under the family Euphorbiaceae and originated from tropical region of South East Asia, particularly central and southern India (Morton, 1960). Aonla plants are hardy in nature that is why it can be grow successfully in wastelands and salt affected soil without hampering the yield. It can be grown under well drained fertile loamy and moderately alkaline soils by deep root system. It exhibits deciduous nature due to abscission and shedding of determinate shoot during February and March. Aonla can with stand in drought conditions especially in summer month through zygote-dormancy mechanism of the plants and fruit began to swell during onset of monsoon. Intensive plantation of aonla is being done in the salt affected soils in the districts of U.P. including ravenous area of Agra, Mathura, Etawah etc. Due to high nutritive and therapeutic value of aonla, like antioxidants (gallic acid and leucoanthocyanin), antibacterial and antiviral capacity, it makes vital fruit of 21st century (Bakshi., *et al.,* 2015). Aonla is the rich source of vitamin C (600 mg/100 g fruit pulp), iron, calcium and phosphorus with fair source of carbohydrates, carotene, thiamine and riboflavin. It is the important ingredient of chyawanprash and triphala powder production.Now a day, many complaints are coming from growers that there is heavy premature fruit drop and reduced yield and quality of aonla. These may be scarcity of water resources, low availability of plant nutrients, poor soil condition, extremes of temperature (high and low), desiccated wind, less precipitation which leads to low productivity and quality. The success of aonla cultivation under arid ecosystem is largely based on efficient management of available natural resources (Shukla, *et al.,* 2004). Macro and micro-nutrients are playing a vital role in improving fruit set, fruit growth and development, yield and quality (Asrey, *et al.,* 2007). These nutrients are also very much essential to overcome various nutritional and physiological disorders in fruit trees which are caused by deficiency or excess of individual nutrients. The foliar spray of micro-nutrients like Boron and zinc sprays are extremely beneficial during photosynthesis because boron promote accumulation of carbohydrate and improved fruits quality while zinc activates the amino acid synthesis and help in auxin biosynthesis since zinc greatly enhanced photosynthesis activities of the plants (Singh *et al.,* 2012). Aonla is very important minor fruit crop due to availability of plenty nutrient contents but heavy fruit drop is a major problem of this crop which considerably reduce the fruit yield. The foliar spray of micro-nutrient can minimise the fruit drop as well as maximise the yield and quality of aonla fruits. Therefore, the present research work was carried out with the foliar application of nutrients on aonla (cv. NA-6) fruits to find out the suitable nutrient combination to increase yield traits.

MATERIALS AND METHODS

A field experiment was conducted at Main Experimental Station

on sixteen year old aonla (cv. NA-6) tree along with P.G. Laboratory of Department of Horticulture, Narendra Deva University of Agriculture and Technology, Faizabad, (UP)during 2012-2013. The experimental field come under sub humid and sub-tropical climate with received average annual rainfall about 1200 mm, out of which about 85% concentrated from mid June to end of September. The winter months are cool (lowest temperature upto 5ºC), dry and occasional frost occurs during this period. Westerly Hot (temperature upto 45ºC) wind starts from the month of March and continues up to the onset of monsoon. There were following seven foliar nutrient application treatments *i.e.* T_1- Control (Water spray), T_2- Calcium nitrate (1%), T_3- Potassium sulphate (2%), T_4- Zinc sulphate (0.5%), T_5- Calcium nitrate (1%) + Potassium sulphate (2%), T_6- Calcium nitrate (1%) + Zinc sulphate (0.5%), T_7- Calcium nitrate (1%) + Zinc sulphate (0.5%) + Potassium sulphate (2%). These treatments were arranged in randomised block design with three replications and treatments were imposed at two different stages, *i.e.* first application just after fruit set (April month) and second during July month. The different nutrient solutions were prepared separately by dissolving the required amount of water and in each solution a surfactant (Teepol) was also added @0.1% for better response of applied nutrients. Fruit drop and their retention were recorded on selected branch lets at monthly interval till the fruit harvesting and per cent value was calculated. The mature fruits were harvested from each treatment and fruit weight (kg/tree) was recorded with weighing machine by taking randomly 10 fruits mean value and counting of total number of fruits on the plant. The yield attributes like fruit size, weight and volume were recorded after harvesting.

RESULTS AND DISCUSSION

Fruit Set and Fruit Drop

Fruit setting is directly linked with yield attributes because elevated fruit setting provide highest yield and this feature have significantly altered by the foliar applications of calcium nitrate, zinc sulphate and potassium sulphate. The combined spray of calcium nitrate (1%), zinc sulphate (0.5%) and potassium sulphate (2%) were obtained significantly maximum fruit retention (28.4%) and minimum fruit drop (71.6%) as compared to other treatment combinations. The beneficial effect of calcium nitrate, zinc sulphate and potassium sulphate in increasing fruit set might be due to the higher availability of photosynthates. These nutrients also modify the hormone metabolism.The spray of Zinc sulphate promotes auxin synthesis by delayed the formation of abscission layer during early stages of fruit development. Fruit retention is an integral part for prolific bearing of tree. The maximum fruit retention and minimum fruit drop might be due to calcium element because it is major constituent of middle lamella of the cell walls. The calcium pectate is the principal constituents for strengthening of pedicel which attached to proximal end of fruit and finally reduce fruit drop. Similar findings were also found on foliar application of boron and zinc in aonla fruits cv. Banarasi (Meena, *et al.,* 2014).

Fruit Characters

Fruit attributes were altered significantly by the application of nutrients. The result of this experiment was clearly indicated that the fruit size was noticeably improved in all the treatment combination as compared to control. The maximum fruit length (4.3 cm) and breadth (4.4cm) was recorded by the foliar application of calcium nitrate, zinc sulphate and potassium sulphate with the concentration of 1%, 0.5% and 2%, respectively, which was at par with the combine application of calcium nitrate (1%) along with potassium sulphate (2%) and calcium nitrate (1%) with zinc sulphate (0.5%). The separate foliar application of zinc sulphate (0.5%) was recorded largest fruits as comparison to individual foliar application of calcium nitrate and potassium sulphate. The maximum fruit volume (41.4 cm^3) was recorded with foliar spray of calcium nitrate (1.0%), zinc sulphate (0.5%) and Potassium sulphate (2.0%) which was significantly superior over the entire nutrient applied on the plants other than that the spray of calcium nitrate (1.0%) with zinc sulphate (0.5%) and calcium nitrate (1.0%) with potassium sulphate (2.0%). The fruit size was considerable increased by the spraying of zinc and it might be recognized due to efficient absorption and subsequently more luxuriant vegetative growth in the initial stage. It also influenced the activity of metabolism in plant which attributed to better development of fruit. The present findings have also been confirmed by application of

Table 1: Influence of foliar spray of nutrient on fruiting and yield of aonla fruit

Treatment	Dormancy period (Days)	Fruit drop (%)	Fruit retention (%)	Days taken in maturity	Fruit length (cm)	Fruit Breadth (cm)	Volume of fruit (cm^3)	Fruit weight (g)	Fruit Yield (Kg/tree)
T_1-Control (water spray)	94	81.2	18.9	202	3.7	3.7	32.5	33	49.5
T_2-Calcium nitrate (1.0%)	89	76	25	198	3.8	3.9	34.4	34	51.8
T_3-Potassium sulphate (2.0%)	88	75	24	187	3.6	3.9	35.7	36	52.9
T_4-Zinc sulphate (0.5%)	93	74.2	25.9	195	3.9	4	37.5	37.5	53
T_5-Calcium nitrate (1.0%) + Potassium sulphate (2.0%)	87	72.5	27.5	185	4.2	4.3	39.1	40.8	58.3
T_6-Calcium nitrate (1.0%) + Zinc sulphate (0.5%)	87	73	27.1	194	4	4.2	38	38.6	56.6
T_7-Calcium nitrate (1.0%) + Zinc sulphate (0.5%) + Potassium sulphate (2.0%)	85	71.6	28.4	181	4.3	4.4	41.4	44.3	61.8
S.Em.±	0.79	0.7	0.2	4.9	0.9	0.1	0.5	0.6	1
CD at 5 %	2.3	2.2	0.6	14.2	0.3	0.3	1.7	1.9	3

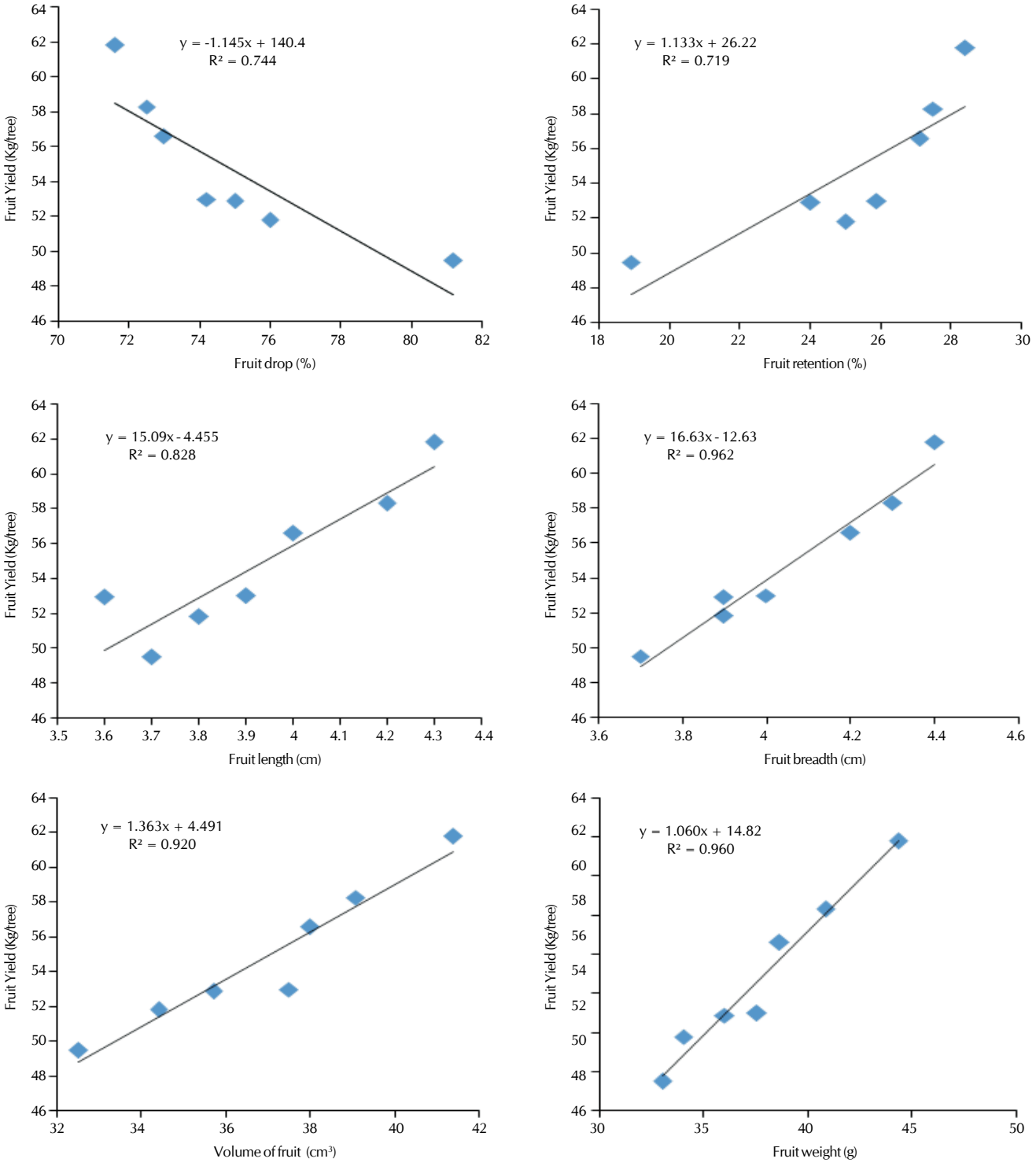

Figure 1: Relationship between yield and yield attributes of anola (on the basis of Table No. 1)

calcium nitrate and calcium chloride on aonla cv. NA-10 (Kumar, *et al.,* 2005), zinc sulphate and thiourea on aonla cv. NA-6 (Khan, *et al.,* 2009) and calcium nitrate, zinc sulphate with boric acid on guava cv. Sardar (Goswami, *et al.,* 2012).

Fruit weight was improved appreciably by macro and micro nutrient application. The maximum fruit weight was recorded with the combined spray of calcium nitrate (1.0%), zinc sulphate (0.5%) and potassium sulphate (2.0%) which was significantly higher over other nutrient combinations. 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 in mango (Banik, *et al.,* 1997).

The foliar spray of boron, zinc and copper increased fruit set, size, weight and yield of aonla fruit cv. Banarasi (Singh, *et al.,* 2012).The increasing fruit weight due to the effect of nutritional treatments on the plants and especially zinc plays a vital role to promote starch formation and potassium actively in transportation of carbohydrates (Gurjar *et al*., 2015).

It is clearly evident from results that the highest fruit yield (61.8 kg/tree) was harvested with combined spray of calcium nitrate (1.0%), zinc sulphate (0.5%) and potassium sulphate (2.0%), which was significantly superior over all the nutrient treatments. A number of earlier reports are available to confirm the present findings that foliar application of nutrient is helpful in increasing yield in fruit crops. It is possibly due to their directly or indirectly involvement in the more fruit setting and retention with less fruit drops in addition to growth and development of fruits. Fruit yield was found to be positively correlated (Fig. 1) with fruit drop ($R^2 = 0.744$), fruit retention ($R^2 = 0.719$), fruit length ($R^2 = 0.828$), fruit breadth ($R^2 = 0.962$), fruit volume ($R^2 = 0.920$) and fruit weight ($R^2 = 0.960$). These activities improve number of fruit, length of fruits, breadth of fruits and weight of fruit ultimately increases the total yield of fruits. An appreciable increase in yield by foliar application of zinc sulphate in guava (Awasthi, *et al.,* 2004), spray of calcium nitrate increase the fruit yield in mango (Bhatt, *et al.,* 2012).

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