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Effect of Foliar Feeding of Nutrients onGrowth and Yield of Aonla [(*Emblica officinalis* Gaertn.) cv. Chakaiya]

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A B S T R A C T

The present investigation entitled on Effect of Foliar Feeding of Nutrients on growth and yield of Aonla (*Emblica officinalis* Gaertn.) cv. Chakaiyawas carried out at the Main Experimental Station, Department of Horticulture, NDUA&T, Kumarganj, Faizabad (U.P.) during the year 2015-16. The experiment was conducted over 28 trees which are Planted at spacing of 10m×10m having seven treatments consisting of various level of nutrients concentration [T_1- Control, T_2- Urea (2%), T_3-KCl (0.2%), T_4- $ZnSO_4$ (0.4%), T_5- Urea (2%) + KCl (0.2%), T_6- Urea (2%) + $ZnSO_4$ (0.4%), and T_7- Urea (2%) + $ZnSO_4$ (0.4%) + KCl (0.2%)] in RBD design with 4 replications. The nutrient spray was applied two times after fruit set in the month of May and July. Among different dose of nutrient treatments, T_7- Urea (2%) + $ZnSO_4$ (0.4%) + KCl (0.2%) were found significantly superior over other treatments with respect to fruit size, fruit weight, pulp weight, fruit yield and pulp : stone ratio, where as maximum fruit retention was found under T_4- $ZnSO_4$ (0.4%) which was significantly superior over other treatments.

Introduction

Aonla, commonly known as Indian Gooseberry (*Emblica officinalis* Gaertn.) a tropical minor fruit of commercial importance is quite hardy, prolific bearer and highly remunerative even without much care. It belongs to family Euphorbiaece and order malpighiales and is known as amla, amlaki, amali, ambala, amalakamu, and nelli in different parts of India. It is native to tropical region of the South-East Asia, particularly Central South India. It is being cultivated since long back and occupies important place among the indigenous fruit of India. Aonla finds mention in 'Vedas,' 'Ramayana' 'Charak Samhita' 'Sushrut Samhita' and other ancient Indian literatures describing its fruits as highly valuable food, medicine and hair dye. Aonla is one of the most nutritious fruit and second richest source of vitamin-C after Barbados cherry. The vitamin C content in aonla varies from 200-900 mg /100 g depending upon the variety and size of the fruit. The ascorbic acid and other constituents are well retained in dried aonla fruits. The

stability of ascorbic acid and presence of astringency in aonla fruits is due to polyphenols and leucoanthocyanins which retard oxidation of vitamin- C (sastry *et al.*, 1956).Considering the high productivity per unit area, hardy nature, medicinal value and number of uses, there is huge scope. It is one of most important fruit of 21st century. In the recent years, considering its prospects under waste land conditions, particularly in salt affected soils, the area under aonla cultivation is increasing rapidly in the states of Uttar Pradesh, Rajasthan, Maharashtra, Gujarat, Madhya Pradesh, Haryana and Andhra Pradesh etc. Now - a- days many complaints are coming from growers that there is low yield with inferior quality fruits leading to low profitability. This may be due to many reasons. The micronutrient plays the vital role in improving fruit growth and yield. The foliar application of these substances has gained much importance in recent years and comparatively more effective for rapid recovery of plant, as under high soil p^H condition. Among the commercial grown varieties, 'Chakaiya' / 'Chakala' is the most 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, late fruit maturity, medium fruit size, rich in Vitamin-C content and prolonged shelf life. However, the occurrence of severe fruit drop, poor fruit quality and incidence of nutritional disorders have been observed in old aonla orchards, which resulted to declining of cultivated areas in commercial fruit belts of aonla in eastern Uttar Pradesh. The role of micro nutrients for improving the growth and development, fruit set, control of fruit drops, fruit maturation, fruit yield, fruit quality and over coming of physiological and nutritional disorders have been well established in number of topical, sub-tropical and temperate fruit crops [Singh *et al.*,(1976), Bhatia and Yadav (2003) and Singh *et al.*, (2007)]. Among the foliar application of different level of nutrients viz. Zinc, copper, Boron, Urea, potassium and manganese have been found more effective in improving the flowering, fruit set, fruit size, fruit yield and fruit quality in number of fruit crops. Considering aonla as a minor fruit crop there is no major work done to improve the growth and yield hence considering the need, Present investigation entitled "Effect of Foliar Feeding of Nutrients on growth and yield of Aonla cv. Chakaiya" has to be planned with the objective, to study the effect of Urea, Zinc Sulphate and KCl on growth and yield of aonla.

Materials and Methods

The present investigation entitled "Effect of Foliar feeding of Nutrients on growth and yield of Aonla (*Emblica officinalis* Gaertn.) cv. Chakaiya" was carried out at Main Experiment Station, Horticulture and analytical works undertaken in P.G. Laboratory, Department of Fruit Science during the year of 2015-16. 28 trees having uniform growth were selected randomly from experimental block before foliar application of nutrients. The standard cultural operations and basal application of manures and fertilizers were applied as per recommended schedule for aonla plantation.

Treatment details

Seven treatments consist of different concentrations of nutrients and their combinations are given below:

T_1 : Control (Water Spray)
T_2 : Urea (2%)
T_3 : KCl (0.2%)
T_4 : $ZnSO_4$ (0.4%)
T_5 : Urea (2%)+ KCl (0.2%)
T_6 : Urea (2%) + $ZnSO_4$ (0.4%)
T_7. : Urea (2%) + $ZnSO_4$ (0.4%) + KCl (0.2%)

Method for preparation of nutrient solution

The solutions were prepared as per required concentrations of nutrients (Urea, Zinc sulphate and KCl). The required quantity of nutrients was weighed using balance and dissolved in distilled water in measuring cylinder, and volume made up to 10 liters

Methods of foliar spray

Foliar spray of nutrients was applied twice after fruit set. The first spray of nutrients was applied during 15 May 2015 and second sprays after Two months of first spray (15 July) at the time of fruit bud development stage with using Aspee pneumatic foot sprayer fitted with nozzle.

Results and Discussion

Fruit drop (%)

The observation on fruit drop was recorded during the fruit bud development and fruit maturation stage

(i) Pea stage (September) (ii) Marble stage (October) (iii) Maturity stage (November).

The four bearing branches in four directions on each treated tree were tagged and total numbers of fruit buds/fruitlets were counted. The number of fruit buds/fruit lets dropped on each branch were counted at different stages of fruit development. The average numbers of fruits dropped from each branch were calculated in to per cent of fruit drop by using following formula.

$$\text{Fruit drop } \% = \frac{Ni - Nr}{Ni} \times 100$$

Where,

Ni = Total number of fruits/fruit lets per branch at initial stage

Nr = Number of fruits retained per branch at fruit maturity stage

Fruit retention (%)

The per cent fruit retention was calculated using the following formula.

$$\% \text{ fruit retention} = \frac{\text{Total no.of fruits retained per branch till maturity}}{\text{Total no.of fruits set per branch}} \times 100$$

Fruit length (cm)

The fruit length was measured at fruit maturity/harvesting stage. The fruit length was measured in centimetre with the help of calibrated Vernier Callipers. The 10 fruits collected from the tagged branches were measured for average length of fruit.

Fruit width (cm)

The fruit width was measured at fruit maturity/harvesting stage. The fruit width was measured in centimetre with the help of calibrated Vernier Callipers. The 10 fruits collected from the tagged branches were measured for average width of fruit.

Weight of the fruit (g)

The average fruit weight was recorded at full maturity stage. The 10 fruits were collected from the tagged branches and weighed on the top loading electrical balance and average fruit weight was recorded in grams.

Pulp weight (g)

After removal of pulp from the fruits, the average weight of pulp was recorded in grams with help of physical balance.

Pulp: stone ratio

After removal of pulp and stone from the fruit separately, the pulp : stone ratio was calculated using the following formula;

$$= \frac{\text{Total Wt. of fruit} - \text{Wt. of stone}}{\text{weight of stone}} \times 100$$

Fruit yield (Kg/tree)

The total fruit yield per tree was recorded after harvesting mature fruits. The average fruit yield (kg per tree) was recorded as per treatments.

Statistical analysis

The statistical analyses of experimental data recorded during the experimentation period were estimated as per treatment using the statistical method as suggested by Chandel (1984).

The standard error (S.Em ±) for the difference of treatments means were computed as follows.

$$\text{S.Em} \pm = \sqrt{\frac{\text{MSE}}{\text{r}}}$$

Where,
MSE = Mean sum of square due to error.
r = Number of replications.

The calculation of C.D. at 5% of table value was calculated with the help of following formula.

$$\text{CD} = \text{S.Em} \pm \text{x } t_{5\%}$$

Where,
C.D.= Critical difference
S.Em ± = Standard error of mean

The minimum (74.35) fruit drop was recorded with spray of zinc sulphate (0.4%), followed by Urea (2%) + zinc sulphate (0.4%) + KCl (0.2%). Application of Urea and Zinc Sulphate has been found effective to reduce fruit drop in mulberry (Singh *et al.*, 2007). Reduction in fruit drop may be due to the fact that zinc is present in several dehydrogenase and proteinase enzymes and involved in the biosynthesis of auxin, which promotes flowering and fruit setting in plants.

Maximum fruit retention was observed with the spray of Zinc sulphate (0.4%) followed by Urea (2%) + Zinc sulphate (0.4%) + KCl (0.2%). Spray of NAA + potassium + $ZnSO_4$ proved most effective in reducing fruit drop and increasing the fruit retention in ber cv. Banarasi karaka. It is in close conformity with the findings of Sharma *et al.,* (2005).

Fruit size was markedly improved by all the nutrients over control. The maximum fruit length (3.18cm) and width (3.71cm) was recorded with combined spray of Urea (2%) + Zinc sulphate (0.4%) + KCl (0.2%). The result is in closely conformity with the finding of Kumar (2004), Dutta and Banik (2007).

The reason for increase in fruit size with spraying of zinc, urea and KCl might be attributed to efficient absorption and consequently more luxuriant vegetative growth in the initial stage which influenced the activity of metabolism in plant which was attributed to better development of fruits. The present findings have been also confirmed by application of zinc sulphate and urea increases the fruit size of aonla cv. NA-6 (Khan *et al.,* 2009).

The maximum fruit weight (32.85) was recorded with the combined spray of Urea (2%) + Zinc sulphate (0.4%) + KCl (0.2%) followed by Urea (2%) + KCl (0.2%). The involvement of Zinc, boron and potassium directly in growth through translocation of food material might be responsible to improve weight of fruits. These results are in close conformity with the spray of Zinc sulphate, Borax and $CuS0_4$ in aonla Singh *et al.,* (2001), Ghosh*et al.,* (2009).

Table.1 Effect of nutrients on fruit growth and yield

Treatments	Fruit drop (%)	Fruit retention (%)	Fruit Length (cm)	Fruit width (cm)	Fruit Weight (g)	Pulp Weight (g)	Pulp : Stone Ratio	Yield (kg)
T_1 Control	81.08	18.92	2.77	3.16	28.91	26.06	9.72	54.21
T_2 Urea (2%)	79.76	20.24	2.98	3.65	31.80	29.48	11.53	70.74
T_3 KCl(0.2%)	76.62	23.40	2.91	3.36	32.25	29.96	11.56	69.75
T_4 $ZnSO_4$ (0.4%)	74.35	25.65	2.89	3.55	31.50	29.42	11.22	64.69
T_5 Urea (2%) + KCl(0.2%)	75.56	24.45	2.90	3.59	32.55	30.29	11.62	72.95
T_6 Urea (2%) + $ZnSO_4$ (0.4%)	75.14	24.86	3.02	3.53	32.36	30.10	11.90	79.76
T_7 Urea (2%) +$ZnSO_4$ (0.4%) + KCl (0.2%)	74.49	25.32	3.18	3.71	32.85	30.70	12.23	82.25
SEm ±	**1.45**	**1.46**	**0.07**	**0.11**	**0.74**	**0.64**	**0.20**	**3.80**
CD at 5%	**4.29**	**4.34**	**0.21**	**0.34**	**2.21**	**1.91**	**0.58**	**11.29**

The maximum pulp: stone ratio (12.23) and pulp weight (30.70g) was recorded with the combined spray of Urea (2%) + Zinc sulphate (0.4%) + KCl (0.2%), followed by Urea (2%) + KCl (0.2%). Singh *et al.*, (2004) reported that spray of urea and Zinc sulphate increase the pulp: stone ratio of aonla fruit. 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 conversion and translocation of total sugars and minerals during the process of fruit development and fruit maturation (Table 1).

The highest yield per tree (82.25 Kg) was recorded with the spray of Urea (2%) + Zinc sulphate (0.4%) + KCl (0.2%) followed by Urea (2%) + Zinc sulphate (0.4%) which was found significantly superior over control. This may be due to involvement of zinc, urea and KClin synthesis and transport of photosynthate and subsequent conversion into carbohydrate and protein. Foliar application of Urea, $ZnSO_4$, magnesium sulphate and growth regulators significantly increased fruit yield of Ber (Sharma *et al.,* 2011).

The present investigation effect of foliar feeding of nutrients on growth and yield of aonla concluded that combined foliar application of Urea (2%) + $ZnSO_4$ (0.4%) + KCl (0.2%) was found to be most effective in reducing the intensity of fruit drop and improving fruit retention, fruit size and fruit weight, pulp: stone ratio and fruit yield as compared to other treatments. Based on overall experimental findings it may be concluded that Two foliar sprays of Urea (2%) + $ZnSO_4$ (0.4%) + KCl (0.2%) immediately after fruit set and two month after fruit set in aonla cv. Chakaiya can be recommended for aonla growers of Uttar pradesh for better growth and yield of fruits.

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