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Short communication

Effect of foliar application of calcium nitrate and urea on yield and quality of *aonla*

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Aonla (*Emblica officinalis* G.) is an indigenous fruit to Indian sub-continent and suited well in dry subtropical climate. It is grown commercially because of high therapeutic and nutritional value as well as suitable for marginal lands (Singh *et al*., 6). In the recent years, considering its prospects under wasteland conditions particularly in salt-affected soils, the area under *aonla* cultivation is increasing rapidly. The higher calcium level in fruit pulp results lower cumulative physiological loss in weight. Calcium nitrate increases fruit firmness up to twenty percent (Casado *et al*., 1), which maximizes the risk of fruit quality loss due to different physical injury. Calcium has various effects on *aonla* fruit with respect to its TSS, total sugars, phenols, acidity, ascorbic acid, reducing sugar etc. (Yadav and Singh, 8). Nitrogen when applied as foliar spray has been found effective on physico-chemical properties of *aonla* (Singh *et al*., 6). Therefore the present study was conducted with objective to find out the optimum concentration of urea and calcium nitrate as foliar application on yield and quality of *aonla* fruits.

The present investigation was carried out at Experimental Orchard and P.G. Laboratory of Horticulture, College of Agriculture, Indore. The site has subtropical climate having a temperature range of 23° to 41°C and 4° to 29°C in summer and winter season, respectively. The representative soil samples were collected and tested for its physical and chemical properties. The soil of the field was typical medium black having a high capacity to swell and shrink and high CEC due to dominance of clay content. Available nitrogen, phosphorus, potash and sulphur were found 235.0, 10.1, 820.0 and 2.16 kg/ha, respectively in the soil. While pH, electrical conductivity and organic carbon was 7.4, 0.5 dS m^{-1} and 0.57%, respectively. Nine-year-old plants of *aonla* cv. Narendra Aonla-7, uniform in vigour and productivity, were selected as experimental material employed under factorial randomized design with three replications and spacing at 8 m × 8 m distance. A total of 12 treatments of calcium nitrate (0, 1, 1.5 and 2%) and urea (0, 1 and 2%) in combinations were used as foliar sprayed to 3 plants per treatment. A set of physical and chemical characters, *viz*., fruit diameter, fresh fruit weight, specific gravity of fruit, stone weight, pulp-stone ratio, moisture content, TSS, acidity, ascorbic acid content, total sugars, calcium content and yield were recorded following standard procedures. The mean difference and analysis of variance for the factorial RBD was carried out as outlined by Panse and Sukhatme (4) to test the significance level among the treatments.

The present study showed the significant and positive interaction between calcium nitrate and urea (Table 1). A perusal of Table 2 showed the highest fruit diameter (5.67 cm) with the foliar application of T_{12} (2% calcium nitrate + 2% urea) followed by T_9 (5.65 cm) as compared to the lowest (4.50 cm) with control T_1. Effect of calcium nitrate and urea (alone) showed increasing trend for fruit diameter as the level of treatment increased up to 2%. Similar trend was noted for fruit weight in the treatments T_{12} and T_9. These results were expected due to availability of nitrogen through calcium nitrate and urea both which might have attributed towards activity of metabolism in plant resulted in better development of fruit. Specific gravity of the fruit was found to be the highest (1.28 g/cc) with the foliar application of T_{12} (2% calcium nitrate + 2% urea) followed by T_9 (1.25 g/cc). The 2% calcium nitrate as foliar feeding was found to be most effective as compared to the other levels of urea to gain highest specific gravity. On the other hand 2% urea gave the highest specific gravity irrespective of other factor. These results were in agreement with the findings of Pandey *et al.* (3), Singh *et al.* (6), and Tomar and Singh (7).

As apparent from the Table 2, the highest stone weight was observed in T_{12} and T_9 (2.46 g) followed by T_8. The lowest stone weight (1.74 g) was found in T1 (0% calcium nitrate + 0% urea). In contrary to the above results highest pulp-stone ratio (18.97) was recorded with the foliar application of T_1 while the lowest was recorded with the T_{12}. The deposition of calcium and nitrogen content might be the reasons for better development of stone by the treatment of T_{12} as oppositely by T_1. The highest moisture content was evidenced with the foliar application of T_6 (1%

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Table 1. Analysis of variance of different physical and chemical characters of *aonla* variety Narendra Aonla-7.

Source	Df	Fruit dia. (cm)	Fresh fruit weight (g)	Specific gravity (g/cc)	Stone weight (g)	Pulp-stone ratio	Moisture (%)	TSS (°Brix)	Acidity (%)	Ascorbic acid (mg/ 100 g)	Total sugars (%)	Calcium content (mg/ 100 g)	Yield (kg/ ha)
Replication	2	0.055	0.472	0.001	0.007	0.31	0.27	0.05	0.001	71.75	0.006	9.3	369.6
Calcium nitrate (Factor A)	3	0.875**	37.5**	0.003*	0.282*	5.37*	3.54**	1.11**	0.05**	4289.3**	0.23*	3269.6**	2571**
Urea (Factor B)	2	0.689**	52.5**	0.125**	0.286*	9.42*	54.32**	3.05**	0.13**	451.7**	0.38**	4270.5**	2680**
Factor A x Factor B	6	0.221**	31.6**	0.004*	0.385*	1.79*	2.77**	0.16*	0.02**	142.5*	0.08**	219.2**	1414**
Error	22	0.025	4.57	0.001	0.09	0.11	0.42	0.03	0.003	45.9	0.014	28.8	242

*, **Significant at 5 and 1% levels.

Table 2. Effect of foliar application of different levels of calcium nitrate and urea on physical and chemical characters of *aonla* variety Narendra Aonla-7.

Treatment	Fruit dia. (cm)	Fresh fruit weight (g)	Specific gravity (g/cc)	Stone weight (g)	Pulp-stone ratio	Moisture (%)	TSS (°Brix)	Acidity (%)	Ascorbic acid (mg/ 100 g)	Total sugars (%)	Calcium content (mg/ 100 g)	Yield (kg/ ha)
T_1	4.50	46.42	1.02	1.74	18.97	66.43	8.57	2.04	504	4.86	755	3968
T_2	4.87	49.50	1.15	2.00	17.57	70.37	9.45	2.15	519	5.21	786	4498
T_3	4.97	50.70	1.21	2.13	16.78	72.57	10.05	2.30	555	5.39	815	4528
T_4	4.82	47.65	1.04	2.08	17.43	68.10	9.57	2.18	524	5.14	779	5201
T_5	5.00	48.63	1.18	2.16	16.70	71.80	9.80	2.32	548	5.32	809	5223
T_6	5.18	51.03	1.24	2.31	15.58	73.30	10.37	2.39	559	5.52	818	5240
T_7	5.08	48.17	1.04	2.14	16.72	68.33	9.63	2.21	544	5.31	801	5365
T_8	5.47	49.37	1.13	2.40	15.81	70.40	9.60	2.31	565	5.42	815	6830
T_9	5.65	51.57	1.25	2.46	15.74	71.77	10.52	2.41	580	5.46	822	7956
T_{10}	5.17	50.87	1.07	2.18	17.21	68.70	9.72	2.25	563	5.39	816	7576
T_{11}	5.40	51.43	1.16	2.34	16.22	69.60	10.18	2.32	577	5.48	830	8557
T_{12}	5.67	56.45	1.28	2.46	15.15	70.77	10.58	2.42	588	5.75	846	8982
LSD at 5%												
Calcium nitrate	0.13	1.97	0.02	0.24	1.24	0.84	0.17	0.05	6.24	0.11	4.96	215
Urea	0.09	1.72	0.02	0.24	1.07	0.73	0.14	0.04	5.40	0.09	4.30	186
Calcium nitrate × Urea	0.25	3.41	0.04	0.49	1.59	1.45	0.29	0.09	10.84	0.19	8.59	372

$T_1 = CN_0 + U_0$, $T_2 = CN_0 + U_1$, $T_3 = CN_0 + U_2$, $T_4 = CN_1 + U_0$, $T_5 = CN_1 + U_1$, $T_6 = CN_1 + U_2$, $T_7 = CN_{1.5} + U_0$, $T_8 = CN_{1.5} + U_1$, $T_9 = CN_{1.5} + U_2$, $T_{10} = CN_2 + U_0$, $T_{11} = CN_2 + U_1$, $T_{12} = CN_2 + U_2$

CN = Calcium nitrate, U = Urea, LSD = Least Significant Difference.

calcium nitrate + 2% urea) whereas lowest was with T_1. Hence, the results approved the concept that increasing the level of urea makes the plant and fruit more succulent and luscious. In the present study, the medium level of calcium nitrate added the characteristics of lusciousness due to moisture content. These observations were in close conformity with the findings of Singh *et al.* (6).

The foliar use of calcium nitrate and urea improved the quality of *aonla* fruits. Total soluble solids and acidity was found maximum with foliar application of T_{12} followed by T_9, while minimum was observed with T_1. With the application of 2% calcium nitrate as foliar spray highest TSS and acidity were obtained as compared to urea levels. However, 2% urea gave highest TSS and acidity with other levels of calcium nitrate. The corresponding increase in acidity might be due to increase in availability of more nitrogen to the fruit trees, which was the constituents of various energy sources like amino acids and amino sugars. Ascorbic acid content was recorded highest (588 mg/100 g) with the application of T_{12} (2% calcium nitrate + 2% urea) followed by T_9 and T_{11}, whereas, lowest ascorbic acid was recorded in T_1. Effect of calcium nitrate and urea alone showed increased trend of ascorbic acid content as the level of treatments increased. These results are in agreement with the findings of Yadav *et al*. (8), Singh *et al*. (6), and Samant *et al*. (5). Similar results were also obtained for total sugars and calcium content parameters. Thus, it proves that application of calcium and nitrogen supplements increase level of the ascorbic acid and total sugars formation in the fruit besides more calcium depositions and consequently improve the quality and yield.

Perusal of data in Table 2 showed that the highest yield (8,982 kg/ha) was recorded with the foliar application of T_{12} (2% calcium nitrate + 2% urea) followed by T_{11} (2% calcium nitrate + 1% urea) and T_8 (1.5% calcium nitrate + 1% urea). Application of 2% of calcium nitrate as foliar spray attained the highest yield over all other factor of urea and 2% urea alone gave the highest yield as compared to all levels of calcium nitrate. The increase in fruit yield is possibly due to the involvement of nutrients which provide more metabolites for the growth and development of fruits by increase in metabolic activities. These activities improve fruit size and weight; and thus ultimately increased the total yield of fruits. These findings match with observations of Yadav *et al.* (8), Ghosh (2), and Tomar and Singh (7).

From the overall studies, it could be concluded that the fruit diameter, fresh fruit weight, specific gravity, stone weight, pulp-stone ratio, moisture content, TSS, acidity, ascorbic acid, total sugars and yield were significantly improved due to application of 2% urea in combination with 2% calcium nitrate.

REFERENCES

1. Casado, V.J., Marchant, S.S., Lucas, G.I. and Martinez, B.R. 2001. Effect of pre harvest calcium treatment on loquat fruit firmness. *J. Plant Nutr.* **18**: 265-70.

2. Ghosh, S.N. 1998. Effect of foliar feeding of different commercial products of hormone and micronutrient on nut yield of cashew. *Env. Ecol.* **16**: 962-63

3. Pandey, R.C., Pathak, R.A. and Pathak, R.K. 1990. Physico-chemical changes associated with growth and development of fruit in ber (*Zizyphus mauritiana* Lamk). *Indian J. Hort*. **47**: 286-90.

4. Panse, V.G. and Sukhatme, P.V. 1967. *Statistical Methods for Agricultural Workers*. ICAR New Delhi, pp. 281-86.

5. Samant, D., Mishra, N.K., Singh, A.K. and Lal, R.L. 2008. Effect of micronutrient spray on fruit yield and quality during storage in *ber* cv. Umran under ambient conditions. *Indian J. Hort*. **65**: 399-404.

6. Singh, D.M., Singh, H.K. and Singh, A. 2004. Effect of foliar nutrient with nitrogen, potassium and zinc on physico-chemical composition of *aonla*. *Indian J. Hill Farming*, **17**: 139-40.

7. Tomar, C.S. and Singh, N. 2007. Effect of foliar application of nutrients and bio-regulators on growth, fruit set, yield and nut quality of walnut. *Indian J. Hort.* **64**: 271-73.

8. Yadav, V.K. and Singh, H.K. 2002. Effect of preharvest application of calcium nitrate, Topsin-M and Bayleton on post harvest life of *aonla* fruit. *J. Appl. Hort.* **4**: 83-86.

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