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Studies on the effect of foliar application of calcium, potassium and silicon on quality and shelf life of sweet orange (*Citrus sinensis* L.) cv. Sathgudi

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Abstract
The experiment "Studies on the effect of foliar application of calcium, potassium and silicon on quality and shelf life of sweet orange (*Citrus sinensis*. L) Cv. Sathgudi" was conducted at Horticultural Research Station, Konda Mallepally in an existing sweet orange orchard on fifteen year old trees. The experiment was laid out in randomized block design (RBD) with thirteen treatments consisted of T_1 - 1.0% KNO_3 (potassium nitrate), T_2 - 1.5% KNO_3 (potassium nitrate), T_3 - 2.0% KNO_3 (potassium nitrate), T_4 - 4 ml/L K_2SiO_3 (potassium silicate), T_5 - 6 ml/L K_2SiO_3 (potassium silicate), T_6 - 8 ml/L K_2SiO_3 (potassium silicate), T_7 - 1.0% $Ca(NO_3)_2$ (calcium nitrate), T_8 - 1.5% $Ca(NO_3)_2$ (calcium nitrate), T_9 - 2.0% $Ca(NO_3)_2$ (calcium nitrate), T_{10} - 1.0% $CaCl_2$ (calcium chloride), T_{11} - 1.5% $CaCl_2$(calcium chloride), T_{12} - 2.0% $CaCl_2$ (calcium chloride), T_{13} - control. Data on quality and shelf life differed significantly among the treatments. it was observed that quality of the fruits were found significantly highest with treatment T_4 - potassium silicate 4 ml/L, with fruit juice content (46.37%), Total soluble solids (12.07 B°), total sugars (6.28%), reducing sugars (4.10%), non-reducing sugars (2.18%), low titrable acidity (0.53%). and shelf life was significantly highest in treatment T_7 - 1% $Ca(NO_3)_2$ shelf life (27.70 days).

Keywords: Foliar spray, potassium silicate, calcium nitrate, quality, shelf life, sweet orange

Introduction
Sweet orange is one of the most popular citrus fruit grown in tropical and sub-tropical regions of India which belongs to the family Rutaceae. Its origin is traced back to China, Northern India and Southern Asia. Sweet orange popularly called as tight skinned oranges in India, mainly cultivated in Telangana, Andhra Pradesh and Maharashtra. The major sweet orange growing districts in Telangana are Nalgonda, Suryapet, Gadwal, Mahaboobnagar and Ranga Reddy. In Telangana, sweet orange occupies an area of 62,904 acres with annual production of 503028 metric tonnes (Commissioner of Horticulture, Telangana State, 2018 - 19) [4]. Among the different cultivars of Sweet orange, Sathgudi is the important commercial cultivar and has wide adaptability. The fruit of this variety is medium, sub globose to spherical in shape, with smooth rind of medium thick orange colour. The flesh colour is straw or orange colour, segments are 10-12 and juice with good flavor and contains considerable amount of vitamin C, dietary fibre (non-starchy polysaccharides) that are essential for normal growth and development. The rind of citrus fruits is rich in pectin and certain essential oils. In sweet orange the chief constituent of the edible portion are sugars (glucose and sucrose), and acids (Citric acid). Foliar application of micro nutrients is more successful than soil application. Calcium is known to play an important role in the quality retention of fruits in maintaining the firmness, reducing respiration rate, ethylene evolution and decreasing rots. Potassium nutrition also affects the mineral uptake and their distribution to different plant parts like shoots, leaves, fruits etc. Market qualities, fruit size, soluble solids and yield increases upon foliar application of potassium. Silicon is also known to increase drought tolerance in plants by maintaining plant water balance, photosynthetic activity erectness of leaves and structure of xylem vessels under high transpiration rates. Therefore, present studies were undertaken with an objective to find out the effect of foliar application of calcium, potassium and silicon on quality and shelf life of sweet orange cv. Sathgudi.

Materials and Methods
The present investigation on "Studies on the effect of foliar application of calcium, potassium and silicon on quality and shelf life of sweet orange (*Citrus sinensis*. L) Cv.Sathgudi"

was carried out at existing sweet orange orchard on 15 years old trees in Horticultural Research Station, Konda Mallepally with 13 treatments i.e., T_1 - 1.0% KNO_3 (potassium nitrate), T_2 - 1.5% KNO_3 (potassium nitrate), T_3 - 2.0% KNO_3 (potassium nitrate), T_4 - 4 ml/L K_2SiO_3 (potassium silicate), T_5 - 6 ml/L K_2SiO_3 (potassium silicate), T_6 - 8 ml/L K_2SiO_3 (potassium silicate), T_7 - 1.0% $Ca(NO_3)_2$ (calcium nitrate), T_8 - 1.5% $Ca(NO_3)_2$ (calcium nitrate), T_9 - 2.0% $Ca(NO_3)_2$ (calcium nitrate), T_{10} - 1.0% $CaCl_2$ (calcium chloride), T_{11} - 1.5% $CaCl_2$ (calcium chloride), T_{12} - 2.0% $CaCl_2$ (calcium chloride), T_{13} – control and 3 replications in randomized block design. All the treatments the spraying intervals are first spray at before bloom stage (one month before flowering), second spray after fruit set, and third spray after a month of second spray. Various observations on fruit quality attributes like juice content, total soluble solids, titrable acidity, total sugars, reducing sugars, non-reducing sugars, ascorbic acid and Shelf life parameters, physiological loss in weight, spoilage were recorded. The data was analyzed as per standard procedures.

Results and Discussion

Quality parameters

Experimental data presented in Table 1 indicated significant differences among the treatments in respect of quality parameters of sweet orange like fruit juice content, total soluble solids, titrable acidity, total sugars, reducing sugars, non-reducing sugars. The maximum fruit juice content (46.37%), Total soluble solids (12.07 B°), total sugars (6.28%), reducing sugars (4.10%), non-reducing sugars (2.18%), low titrable acidity (0.53%) were recorded with T_4 – 4 ml/L K_2SiO_3 (potassium silicate). However, ascorbic acid content is non-significant. The increase in fruit quality may be due to foliar application of potassium and silicon in required quantity at correct time intervals to the plant. Combined effect of both potassium and silicon in the form of potassium silicate was found to be an effective treatment for quality improvement in sweet orange. Silicon and potassium helped in synthesis of more sugars in fruit and thus helped in increasing TSS, an increase in total soluble solids lead to decrease in acidity content. Potassium is helped in sugar translocation and also used as an osmosis agent in opening and closing stomata, an important mechanism of water uptake and usage, more nutrient water uptake resulted in increase of juice content. Similar findings were observed in citrus by Alva *et al*., (2006) [1] who reported that Increase in juice content may be due to regulatory role of potassium in many physiological and bio chemical processes of plant including enzymes activation, protein synthesis, stomatal function, stabilization of internal pH, photosynthesis, turgor related processes and transport of metabolites and extensibility. The above results of the present investigation are in close agreement with the report of Kumar *et al*., (2015) [6] in guava who reported that Increase in Total soluble solids content might be because of potassium that has prominent role in translocation of photo-assimilates, sugars and other soluble solids which are responsible for increased TSS. Bhavya *et al*., (2010) [2] also reported that in grapes Increase in total soluble solids leads to decrease in acidity content, Potassium neutralizes organic acids and plays a role in controlling acidity and pH of the fruit juice. Chaudhary *et al*., (2016) [3] also reported in kinnow mandarin that Potassium is known for helping in sugar translocation in plants, thus its application increases reducing sugar and total sugar. Vijay *et al*., (2016) [12] also reported in sweet orange that increased sugar which minimize the acidity in fruit or other hand the reduction of acidity might be due to increase in TSS in fruits.

Shelf life parameters

The results of the present study given in Table 2 indicated significant differences among the treatments in respect of shelf life parameters of sweet orange. The maximum shelf life recorded in treatment T7 –1% $Ca(NO_3)_2$ (calcium nitrate) with (27.70 days). Increase in shelf life, decrease in physiological loss in weight, and spoilage is due to the ability of calcium nitrate in decreasing the moisture loss, storage reserves and maintaining the firmness, structure of cell wall and cell membrane. The binding action of calcium suppress ethylene production and retard ripening, calcium also reduces respiration rate which ultimately reduce fruit decay percentage. Similar findings were observed in aonla by Kumar *et al*., (2005) [7] who reported that in aonla lowest physiological loss in weight with calcium nitrate application might be the net result of decrease in moisture loss and loss of storage reserves as respiratory substrate. The above results of the present investigation are in close agreement with the report of Garg (2007) [5] in aonla who reported that calcium nitrate had the ability to protect cell membrane from disorganization and other anti-senescence properties. Lakshmana and Reddy (1999) [8] also reported in sapota that the binding action of calcium in the cell wall may suppress ethylene production and retard ripening. Singh *et al.*, (1993) [11] also reported that in mango calcium levels reduces respiration rate which ultimately reduce fruit decay percentage. Lokesh Yadav and Varu (2013) [9] also reported that in papaya calcium is known to play an important role in maintaining the fruit firmness, reducing respiration rate, ethylene evolution and decreasing rot and increase shelf life. Mounika *et al*., (2017) [10] also reported that in mango, calcium nitrate has the potential to control spoilage, prolong the storage life by inhibition of ripening and senescence process by lowering the respiration.

Table 1: Studies on the effect of foliar application of calcium, potassium and silicon on quality of sweet orange Cv. Sathgudi

Treatments	Juice (%)	TSS (°Brix)	Titrable acidity (%)	Total sugars (%)	Reducing sugars (%)	Non-reducing sugars (%)	Ascorbic acid (mg/100g)
T_1 - 1.0% KNO_3	46.13	9.17	0.68	5.24	3.11	2.13	42.66
T_2 - 1.5% KNO_3	43.00	9.04	0.71	5.25	3.12	2.13	44.66
T_3 - 2.0% KNO_3	38.04	9.09	0.68	5.23	3.11	2.12	40.66
T_4 - 4 ml/L K_2SiO_3	46.37	12.07	0.53	6.28	4.10	2.18	45.66
T_5 - 6 ml/L K_2SiO_3	44.31	11.45	0.68	6.00	3.83	2.17	44.33
T_6 - 8 ml/L K_2SiO_3	41.66	11.30	0.69	5.65	3.53	2.12	41.66
T_7 - 1.0% $Ca(NO_3)_2$	40.66	11.03	0.65	5.28	3.16	2.12	42.66
T_8 - 1.5% $Ca(NO_3)_2$	38.72	11.09	0.82	5.27	3.16	2.11	43.33
T_9 - 2.0% $Ca(NO_3)_2$	41.66	10.03	0.70	5.24	3.13	2.11	41.00
T_{10} - 1.0% $CaCl_2$	40.66	11.00	0.67	5.24	3.13	2.11	42.66

T_{11} - 1.5% $CaCl_2$	38.33	11.37	0.71	5.22	3.11	2.11	42.00
T_{12} -2.0% $CaCl_2$	39.00	9.07	0.9	5.25	3.13	2.12	43.33
T_{13} - Control	37.66	9.04	1.10	5.21	3.11	2.10	40.00
S.Em±	1.01	0.21	0.04	0.15	0.07	0.01	1.39
CD	2.97	0.62	0.11	0.46	0.23	0.02	N/A

Table 2: Studies on the effect of foliar application of calcium, potassium and silicon on shelf life of sweet orange Cv. Sathgudi

Treatments	PLW at 7th day	PLW at 14th day	PLW at 21st day	Shelf life (days)	Spoilage (%) at 15th day	Spoilage (%) at 20th day	Spoilage (%) at 25th day
T_1 - 1.0% KNO_3	6.20	8.51	12.77	19.44	2.60	3.73	4.20
T_2 - 1.5% KNO_3	6.40	8.61	12.80	19.87	2.23	3.75	4.22
T_3 - 2.0% KNO_3	6.60	8.66	12.82	20.21	2.36	3.80	4.45
T_4 - 4 ml/L K_2SiO_3	5.89	8.11	12.33	21.07	2.16	3.81	3.75
T_5 - 6 ml/L K_2SiO_3	6.08	8.22	12.46	21.00	2.26	3.79	3.83
T_6 - 8 ml/L K_2SiO_3	6.29	8.35	12.67	19.81	1.44	3.90	3.97
T_7 - 1.0% $Ca(NO_3)_2$	5.61	7.74	11.14	27.70	1.12	1.83	2.90
T_8 - 1.5% $Ca(NO_3)_2$	5.71	7.87	11.29	26.29	1.13	2.14	2.90
T_9 - 2.0% $Ca(NO_3)_2$	5.75	7.91	11.60	25.48	1.16	2.49	2.96
T_{10} - 1.0% $CaCl_2$	5.80	7.96	12.19	22.76	1.15	2.66	3.70
T_{11} - 1.5% $CaCl_2$	5.76	8.03	12.08	24.04	1.15	2.60	3.67
T_{12} - 2.0% $CaCl_2$	5.71	7.89	11.77	25.52	1.14	2.54	3.50
T_{13} - Control	5.72	10.21	13.34	17.66	2.70	4.62	6.35
S.Em±	0.008	0.035	0.37	0.60	0.11	0.16	0.20
CD	0.02	0.10	1.11	1.77	0.33	0.48	0.59

Conclusion

Based on the above results, it can be concluded that, to increase the quality of Sweet orange cv. Sathgudi, trees should be sprayed with 4 ml/L potassium silicate and for increasing the shelf life 1.0% calcium nitrate should be sprayed at recommended time intervals to get remunerative price.

References

1. Alva Mattos AK, Paramasivam DJ, Patil S, Dou BH. Sajwan KS. Potassium management for optimizing citrus production and quality. Int. J Fruit Sc 2006;6:3-43.
2. Bhavya HK. Effect of foliar silicic acid and boron in Bengaluru blue grapes, M. Sc. Thesis, Univ. Agric. Sci. Bengaluru 2010; P95.
3. Chaudhary P, Kaushik RA, Rathore RS, Sharma M, Kaushik MK. Improving growth, yield and quality of Kinnow mandarin through foliar application of potassium and zinc. Indian J Hort 2016;73(4):597-600.
4. Commissioner of Horticulture, Telangana State, Area, production and productivity of major horticultural crops in Telangana 2018–19.
5. Garg V. Effect of harvest maturity and some biochemical treatments of storage quality of aonla (*Embrlica officinales gacrtn*.) Ph. D. Thesis, Dr. Y.S Parmar University of Horticulture and Forestry, Nauni-Solan (H.P.) 2007.
6. Kumar J, Kumar R, Rai R, Mishra DS. Responce of pant prabhat guava trees to foliar sprays of zinc, boran, calcium and potassium at different plant growth stages. The Bioscan 2015;10(2):495-498.
7. Kumar, S, Kumar A, Baig MJ, Choubey BK. Effect of calcium on physic chemical changes in aonla. Indian Journal of Horticulture 2005;62:324-326.
8. Lakshmana, Reddy TV. Effect of pre harvest foliar application of calcium on post-harvest behaviour of sapota cv. Kalipatti fruits. South Indian. J Hort 1999;47(1-6):147-148.
9. Lokesh Yadav, Varu DK. Effect of pre harvest spray and post-harvest dipping of fruit on shelf life and quality of papaya. Asian J Hort 2013;8(2):581-587.
10. Mounika T, Reddy NN, Lakshmi NJ, Veena Joshi. Studies on the effect of post-harvest treatments on shelf life and quality of mango [*Mangifera indica*] cv. Amrapali. Journal of Applied and Natural Science 2017;9(4):2055.
11. Singh BP, Tandon DK, Kalra SK. Changes in post-harvest quality of mangoes affected by pre harvest application of calcium salts. Scientia Hort 1993;54:211-19.
12. Vijay RPS, Dalal Beniwal BS, Hemant S. Impact of foliar application of potassium and its spray schedule on yield and quality of sweet orange (*Citrus sinensis*) cv. Jaffa. Journal of Applied and Natural Science 2016;8(4): 1893-1898.