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ISSN: 0974-4908
Res. Environ. Life Sci.
9(5) 599-601 (2016)

Effect of calcium and potassium compounds on physical parameters and chemical composition of fruit of guava (*Psidium guajava* L.)

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(Received: August 14, 2015; Revised received: February 23, 2016; Accepted: February 25, 2016)

Abstract: An experiment was conducted to find out the effect of calcium and potassium compounds on physical parameters and chemical composition of winter season guava. The experiment was laid out with fourteen treatment comprising six nutrients namely calcium chloride, calcium nitrate, calcium sulphate, potassium chloride, and potassium nitrate, potassium sulphate along with water spray and two concentrations (1 and 1.5%) of each nutrient spray of water used as a control. Increasing concentration of nutrients resulted in significant increase in length of fruit (7.70 and 7.81cm), diameter of fruit (8.22 and 8.40cm) and fruit volume (191.00 and 196.67cm^3) were improved significantly with increasing concentration of nutrients and recorded highest values at 1.5% potassium nitrate during both seasons. The chemical composition like total soluble solids (18.87 and 18.73 ^{0}Brix), low acidity as anhydrous citric acid (0.33 and 0.37%) and ascorbic acid (110.09 and 115.68mg/100g). Application of potassium nitrate at higher concentration (1.5%) recorded more value for physical parameters and chemical composition of fruits.

Key words: Physical parameters, Chemical composition

Introduction

Guava (*Psidium guajava* L.) belongs to family Myrtaceae with 150 species under genus *Psidium*, Hayes (1970). Guava is generally cultivated in many tropical and subtropical countries for their nutritive fruits. Its original home of which is said to be the tropical parts of America. It is reported to have been growing in the West Indies since 1526 and was introduced by the Spaniards to the Philippines and by the Portuguese to India by the early 17th century, Menzel and Paxton (1985). It quickly spread to most of the tropical and subtropical world and became naturalized in several countries. Now it is one of the most important subtropical fruit crop in India. Because of its ease of growing, high nutritional value, and the popularity of the processed products, guava is important in international trade as well as for the domestic economy of India.

Guava fruit contains 82.50 g water, 14.5 g carbohydrate, 1.5 g protein, 0.2g fat, 6.9 g fiber, 20 mg calcium, 8 mg phosphorus, 1.4 mg iron, 28 mg potassium, 4 mg sodium, 30 mg vitamin B_1, 0.2 mg niacin, 1.4 mg oxalic acid and 66 calories per 100 g of fruit, Mitra *et al.* (1984). The L-49 is selection from Allahabad Safeda cultivar from Ganesh Khind Garden, Pune. The calcium occurs mainly in the leaves as calcium pectate. Calcium is also plays an important role in cell division, elongation, maintenance of membrane integrity, development and functioning of roots. The calcium comes under the group of macro-nutrient. Champa (1966) worked on nutrient deficiency and postulated that calcium plays an important role in growth activities. The potassium is found in young leaves, root tips and meristematic tissues. It is involved in cell division, synthesis, translocation of carbohydrates and synthesis of proteins in meristematic tissues. It improves the colour, flavour and size of fruits, Bangerth *et al.*(1999).

Materials and Methods

The present investigation was carried out at the Horticulture Orchard, Institute of Agricultural Science, Banaras Hindu University during the year 2012 and 2013. In this experiment there was six nutrients namely calcium chloride (T_1 and T_2), calcium nitrate (T_3 and T_4), calcium sulphate (T_5 and T_6), potassium chloride (T_7 and T_8), potassium nitrate (T_9 and T_{10}), potassium sulphate (T_{11} and T_{12}), along with water spray (T_{14}) and two concentration (1 and 1.5 %) of each nutrient with control (T_{14}). The fresh solution of nutrients will be applied as foliar application at 15 days intervals *viz.* before flowering, flowering and after flowering. Experiment will be laid out in randomized block design with three replications. The spray solutions of various strength was prepared in distilled water and with dehydrate lime solution water to maintained pH and each shoot was sprayed by compressed press sprayer. A total of three mature fruits were sampled from each tree and observation is recorded and averaged to each treatments.

The physical parameter like length of fruits (cm), the fruit length was measured from the stalk end to calyx end using Verneer callipers and expressed in centimetre. The diameter of fruits (cm) was measured at the widest cheeks of fruit using Verneer callipers and expressed in centimetre. The fruit volume (cm^3) was measured using a wide mouth cylinder filled to the brim with water. The fruit was immersed in the cylinder and the run-off collected was measured which gave volume of fruit. The TSS was determined by using 'Erma' hand refractometer (0-32^{0}Brix) and was expressed in ^{0}Brix. Titrable acidity was estimated by titrimetric method and expressed as per cent citric acid as described by Ranganna (1977). 5 ml juice was taken with one to two drops of phenolphthalein indicator and titrated against 0.1N NaOH. The appearance of pink colour marked the end point. Ascorbic acid was estimated by volumetric method by using 2, 6-dichlorophenol indophenol dye as per the procedure suggested by Ranganna (1977) and expressed as mg/100 g pulp. To determine the ascorbic acid, 5 gm fruit pulp was dissolved in 3% metaphosphoric acid and volume was maintained upto 100 ml. 5 ml aliquot were titrated against standardized 2.6 dichloro phenol indophenol dye. The end point marked by the appearance of pink colour persisted atleast 15 seconds. The ascorbic acid was expressed as mg of ascorbic acid per 100 gm pulp of sample (A.O.A.C. 1990).

Results and Discussion

Significantly higher fruit length (cm) recorded under treatment T_{10} (7.70) and also statistically at par with treatment T_4 (7.23), T_9 (7.10) and T_3 (7.03) during first year of experimentation. During second year of experimentation the treatment T_{10} (7.81) attempted maximum fruit length (cm) also found statistically at par to treatment T_9 (7.29), T_4 (7.28) and T3 (7.14). The treatment T_{14} control recorded minimum (5.62 and 5.73) fruit length (cm) as compare to rest of other treatments during both the years of experimentation. Statistically higher fruit diameter (cm) recorded under treatment T_{10} (8.22) and also at par with treatment T_4 (7.78), but significantly superior over rest of other treatments during first year of experimentation.

During second year of experimentation the treatment T_{10} attempted significantly maximum (8.40) fruit diameter (cm) closely followed by treatment T_4 (7.88), T_8 (7.68) and T_9 (7.62). The minimum (5.57 and 5.63) fruit diameter was recorded under control (T_{14}) among all the treatments during both the years of investigation. The significantly higher fruit volume (cm^3) was recorded under treatment T_{10} (191.00) also found statistically at par to treatment T_9 (186.67) followed by T_4 (180.67) during 2012. Treatment T_{10} (196.67) observed with highly significant fruit volume (ml) closely followed by treatment T_9 (190.67) and T_4 (185.67) during 2013.The minimum (145.67 and 149.67) fruit volume (cm^3) was recorded under control (T_{14}) among all the treatments during both the years of investigation. The potassium being a major nutrient is essential for reduction of nitrate in plants. It is essentially required for the production of best quality fruits. It is also involved in the opening and closing of stomata, Dar, Z. M. and Abraham, G.(2004). The possible reason for increase in fruit volume by calcium might be due to faster mobilization of metabolites in to fruits and involvement in cell division and cell expansion as well as increased volume of intercellular space in mesocarpic cells, Kaur, *et al*. (2012), Barua, (2013) and Sharma, *et al*.(2013).

The treatment T_{10} (18.87 and 18.73) showed highly significant value of total soluble solids during both the years of investigation and closely followed by treatment T_9 (17.75 and 17.70), T_4 (15.40 and 15.65) and T_3 (14.15 and 14.23). The treatment T_{14} (8.35 and 8.15) recorded minimum value of total soluble solids (0Brix) as compare to rest of other treatments during both the years of experimentation. The treatment T_{10} (0.33 and 0.37) showed highly significant value of acidity as anhydrous citric acid (%) during both the years of investigation and closely followed by treatment T_9 (0.44), T_4 (0.44), and T_2 (0.44) during first year and treatment T_2 (0.45), T_4 (0.45) and T_7 (0.46) during second year of investigation. The treatment T_{14} (0.56 and 0.57) recorded maximum value of

Table 1. Effect of Ca and K on length of fruit (cm), diameter of fruit (cm) and fruit volume (cm^3) of guava.

Treatment	Length of fruit (cm)		Diameter of fruit (cm)		Fruit volume (cm^3)	
	2012	2013	2012	2013	2012	2013
T_1	6.53	6.60	6.83	6.96	164.00	169.33
T_2	6.67	6.72	7.21	7.36	177.33	175.67
T_3	7.03	7.14	7.49	7.57	169.33	176.00
T_4	7.23	7.28	7.78	7.88	180.67	185.67
T_5	6.24	6.29	7.05	7.14	170.33	176.00
T_6	6.50	6.60	7.20	7.28	167.67	173.00
T_7	6.65	6.77	7.28	7.41	173.33	179.00
T_8	6.76	6.83	7.55	7.68	170.00	175.00
T_9	7.10	7.29	7.44	7.62	186.67	190.67
T_{10}	7.70	7.81	8.22	8.40	191.00	196.67
T_{11}	6.71	6.75	6.54	6.69	164.00	167.33
T_{12}	6.83	6.89	6.94	6.92	169.00	172.00
T_{13}	6.11	6.21	6.64	6.80	157.33	160.67
T_{14}	5.62	5.73	5.57	5.63	145.67	149.67
SEm±	0.27	0.221	0.18	0.146	3.00	1.928
CD (*P*=0.05)	0.79	0.643	0.51	0.425	8.71	5.604

Table 2.Effect of Ca and K on TSS (^{0}Brix), acidity (%) and ascorbic acid (mg/100g) contents of guava.

Treatment	TSS (^{0}Brix)		Acidity (%)		Ascorbic acid (mg/100g)	
	2012	2013	2012	2013	2012	2013
T_1	13.58	13.25	0.54	0.55	113.10	114.69
T_2	13.90	13.75	0.44	0.45	117.07	119.88
T_3	14.15	14.23	0.54	0.55	118.34	119.51
T_4	15.40	15.65	0.44	0.45	117.77	117.08
T_5	12.28	12.10	0.53	0.54	119.19	120.37
T_6	13.10	13.25	0.51	0.56	120.81	121.61
T_7	13.42	12.95	0.45	0.46	124.22	125.45
T_8	13.50	13.65	0.47	0.48	126.31	127.56
T_9	17.75	17.70	0.44	0.47	115.27	116.41
T_{10}	18.87	18.73	0.33	0.37	110.09	115.68
T_{11}	12.35	12.15	0.48	0.49	122.07	123.27
T_{12}	12.60	12.55	0.49	0.50	120.83	122.02
T_{13}	11.70	11.52	0.55	0.56	133.68	134.99
T_{14}	8.35	8.15	0.56	0.57	141.78	143.18
SEm±	0.40	0.33	0.01	0.006	2.47	2.52
CD (*P*=0.05)	1.16	0.97	0.02	0.017	7.18	7.32

acidity (%) among all the treatments during both the years of experimentation. The minimum value of ascorbic acid (mg/100g) content was recorded under treatment T_{10} (110.09) which was also found statistically at par with treatment T_1 (113.10), T_9 (115.27) and T_2 (117.07) during first year of investigation. During second year of experimentation treatment T_1 (114.69) recorded with minimum value of ascorbic acid (mg/100g) content also observed at par to treatment T_{10} (115.68), T_9 (116.41) and T_4 (117.08).The treatment T_{14} (141.78 and 143.18) observed with maximum value of ascorbic acid (mg/ 100g) content among others treatments during both the years of experimentation.

These results are in conformity with the findings of Singh *et al.* (2004), Bhullar, *et al.*(1982) and who noted that TSS, sugar and acid content enhanced by application of calcium and potassium in guava fruits. Increase in TSS content with these micronutrients may be attributed to the quick metabolic transformations of polysaccharides and pectin into soluble compounds and rapid translocation from leaves to the developing fruits due to improved source –sink relationship. The present study indicates that acidity content of guava fruits decreased significantly under different treatments. This is in accordance with the findings of Chandra, *et al.* (1994) and Gleen, G.M., Poovaiah, B.W. (1986). The reduction in acid content may be based on the fact that mineral compounds reduced the acidity in fruits, since it neutralized in parts during metabolic pathway or used in respiratory process as a substrate. Goswami *et al.* (2014), Singh, *et al*. (2013), Goswami, (2014), Attri, *et al.* (2014).

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