

Effect of Paclobutrazol and Post Flowering Foliar Sprays of Nutrients for Accelerating Harvesting of Karonda (*Carissa carandas* Linn.)

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Abstract

An investigation was undertaken to find out the effect of paclobutrazol and post flowering foliar nutrient sprays on harvesting, yield and fruit quality of karonda. Seven treatments consisted of foliar application of paclobutrazol (100 ppm) before flowering and combinations of urea (1%), KNO₃ (3%) and MKP (0.5%) were studied in randomized block design. Use of foliar application of paclobutrazol and nutrients accelerated harvesting in karonda. All foliar sprays improved yield and quality of karonda. The treatment T₃ (1% urea at fruit set and 0.5% MKP 20 Days after fruit set) was the best where 64% of total fruits were harvested before rains.

Keywords: Karonda (*Carissa carandas* Linn.), foliar nutrient sprays, paclobutrazol, harvesting, physico-chemical composition

1. Introduction

Karonda (*Carissa carandas* Linn) belonging to family Apocynaceae, is an unique underexploited native fruit crop in Konkan region of Maharashtra in India. It is a thorny bush, once established can thrive without irrigation. It possesses great prospects as a mono-crop as-well-as an intercrop or live fence in mango and cashew orchard. The fruits are of economical importance, which are small and ellipsoid, 12 mm or more in size turning from green to red and finally black. Mature green fruit and ripe fruit provide ample opportunities for value addition such as preserves, pickle, tarts, syrup, candy etc. The ripe fruit can be consumed fresh and because of its delicacy its demand is increasing. In spite of its potential as a commercial crop, it is neglected by farmers because of certain constraints such as harvesting in rainy season. In general, karonda blooms between February and March and most of the fruits are harvested from May onwards. Though regular monsoon in the region is generally commenced in the first week of June, many times the pre-monsoon rains in the month of May are often experienced. Hence, most of the fruits are trapped in rains and become useless for consumption as well as value addition. The use of post flowering foliar nutrients has found to be beneficial for accelerating the harvesting in the crops like kokum in the region (Haldankar, Somavanshi, Rangwala, Khandekar, & Burondkar, 2012). Nitrogen, phosphorous and potassium are three major essential elements. Nitrogen is essential for rapid growth, increased vigor and retention of fruits. Potash acts as a catalyst which is used as an accelerator of reactions. It influences many physiological processes like cell division, photosynthesis and respiration (Jones, 1979). Phosphorus is an important constituent of all energy transducing mechanism (Rains, 1976). Increase in fruit retention due to KNO₃ is reported by Gupta and Brahmachari (2004) in mango cv. Bombai. Similarly 3 Per cent Urea could increase fruit retention in mango cv. Dasherri (Rajput & Singh, 1989; Singh, 1977). Urea contains 46 per cent nitrogen, KNO₃ consists of 13 per cent nitrogen whereas, MKP composed of 52 per cent phosphorus and 32 per cent potassium. Potassium and phosphorus advance maturity and ripening in fruit crops and also improve the capacity to synthesize starch (Bose, Mitra, & Sadhu, 1988). The nutrients nitrogen, phosphorus and potassium are essential constituents of several metabolically active compounds and are major structural component of cell which increase growth and development of all living tissues (Anonymous, 2006). Nitrogen is a vital element of chlorophyll which imparts vigorous growth and governs utilization of potassium and phosphorus and other elements. The nutrient nitrogen, phosphorus and potassium play pivotal role in growth and development of plants (Tisdal, Nelson, Beaton, & Havlin, 1993). Paclobutrazol is reported for higher total non-

structural carbohydrate and improvement of quality of mango cv. Tommy Atkins (Yeshitela, Teferi, Robbertse, & Stassen, 2004). In foliar feeding the nutrients are applied directly to the site of metabolism which enhance carbohydrate mechanism. Hence, an experiment was undertaken to study the effect of paclobutrazol and post flowering foliar application of nutrients on accelerating harvesting in karonda.

2. Materials and Methods

The experiment was conducted in the plot no. 4, Department of Horticulture, College of Agriculture Dapoli, Dist. Ratnagiri, (M.S.), India during 2009-2010. The soil of experimental plot was lateritic with uniform depth and good drainage conditions. The selected karonda plants were 4 years old grafts of variety Konkan Bold and were of uniform height, planted at 3 x 3m spacing.

Table 1. Treatment Details of foliar sprays of nutrients and paclobutrazol on karonda cv. Konkan Bold.

Treatment No.	Spray before flowering	At fruit set (Foliar spray)	20 days after fruit set (Foliar spray)
T ₁	-	1% Urea	1% Urea
T ₂	-	1% Urea	3% KNO ₃
T ₃	-	1% Urea	0.5% MKP
T ₄	-	3% KNO ₃	0.5% MKP
T ₅	-	3% KNO ₃	3% KNO ₃
T ₆	PBZ 100 ppm	-	-
T ₇ (Control)	-	-	-

Note: MKP- Mono-potassium phosphate, KNO₃ - Potassium nitrate.

The experiment was conducted in randomized block design with seven treatments of foliar sprays of nutrients, paclobutrazol and control (Table 1), replicated thrice with a unit of two plants per treatment per replication. Paclobutrazol was applied as a foliar spray before flowering in the month of December. Nutrients were applied twice as foliar application once at fruit set and another after 20 days of fruit set as per treatment. The nutrient content in each foliar application was different. Urea does not contain nitrogen and phosphorus, while KNO₃ and MKP do not present phosphorus and nitrogen, respectively. Initially, when the fruit grow rapidly, it requires higher nitrogen amount. At the mature and ripe phases, large amounts of phosphorus and potassium are needed.

The observations *viz.*, flowering, fruit retention (%), days required for harvesting, advance in harvesting (days), fruits harvested before rains (kg/plant), fruits harvested after rains (kg/plant), total yield (kg/plant) were recorded. Five fruits per treatment per replication were randomly selected for recording physico-chemical composition *viz.*, fruit weight (g), fruit length (cm), fruit breadth (cm), Total Soluble Solids (°Brix), acidity (%), reducing sugar (%) and total sugar (%). The physico-chemical composition was recorded at 1 month after fruit set, 2 months after fruit set and at harvest. Chemical composition was recorded as per following procedures

2.1 Total Soluble Solid (°Brix)

5g pulp of karonda fruit was crushed in mortar and pestle and transferred to 100 ml beaker and diluted in 1:2 proportions with distilled water. Total soluble solids were found out by using Erma hand refractometer (0 to 32°Brix) and expressed in degree brix (A.O.A.C., 1980).

2.2 Acidity

5g pulp of karonda fruit was crushed in mortar and pestle and transferred to 100 ml volumetric flask. Distilled water was added to make volume upto 100 ml. Then the sample was filtered and 25 ml filtrate was taken in the beaker and was titrated against 0.1N NaOH using phenolphthalein as an indicator. The results were expressed as per cent (Ranganna, 1991).

2.3 Reducing Sugar

5g of pulp was crushed in mortar and pestle was taken in 250 ml volumetric flask. To this, 100 ml of distilled water was added and the contents were neutralized by 1N sodium hydroxide. Then 2 ml of 45 per cent lead acetate was added to it. The contents were mixed well and kept for 10 minutes. Appropriate quantity (2.5 ml) of 22 per cent potassium oxalate was added to it to precipitate the excess of lead. The volume was made to 250 ml with distilled water and solution was filtered through Whatman No. 4 filter paper. This filtrate was used for

determination of reducing sugar content by the method of Lane and Eynon (1923) as described by Ranganna (1977). The results are expressed on per cent basis.

2.4 Total Sugar

In 100 ml volumetric flask, 50 ml of deluded sample prepared for reducing sugar estimation was taken. To this, 5 ml HCl (1:1) was added and allowed to stand at room temperature for 24 hours. The flask was then kept in thermostatic water bath at 70° to 80°C temperature for 30 minutes. The hydrolysed sample was neutralized by adding pinch of sodium carbonate till formation of effervescence stopped. After cooling the volume was adjusted to 100 ml with distilled water. This sample was used for determination of total sugars by the method of Lane and Eynon (1923) as described by Ranganna (1977). Results are expressed on per cent basis.

2.5 Statistical Analysis

The statistical analysis was performed as per the ANOVA suggested by Panse and Sukhatme (1997). The P value for percentage data of fruit retention, fruits harvested before and after rains were estimated by students paired T-Test. SD was computed as per the procedure advocated by Rangaswamy (1995).

3. Results and Discussion

Table 2. Effect of foliar sprays of nutrients and paclobutrazol on fruit retention (%) (mean±SD) and advance in harvesting of karonda cv. Konkan Bold

Treatments	Fruit retention (%)	Days required for harvesting after fruit set	Advance of Harvesting
T ₁ (Urea 1%) + (Urea 1%)	92.10 ^a (92.10±13.22)	90.67 ^b (90.67±10.53)	12.66 ^{bc} (12.66±2.73)
T ₂ (Urea 1%) + (KNO ₃ 1%)	94.03 ^a (94.03±17.50)	93.67 ^b (93.67±18.29)	9.66 ^c (9.66±4.32)
T ₃ (Urea 1%) + (MKP 0.5 %)	95.20 ^a (95.20±9.38)	88.67 ^b (88.67±12.22)	14.66 ^{bc} (14.66±3.01)
T ₄ (KNO ₃ 1%) + (MKP 0.5 %)	90.10 ^a (90.10±16.45)	72.66 ^a (72.66±14.62)	30.67 ^a (30.67±3.88)
T ₅ (KNO ₃ 3%) + (KNO ₃ 3%)	91.40 ^a (91.40±15.81)	91.33 ^b (91.33±14.92)	12.00 ^c (12.00±4.00)
T ₆ (PBZ 100 ppm)	87.70 ^a (87.70±15.00)	88.00 ^b (88.00±12.00)	15.33 ^a (15.33±3.49)
T ₇ – Control	60.20 ^b (60.20±9.26)	103.33 ^b (103.33±5.98)	0
Range	95.20-60.20	103.33-72.66	9.66-30.67
SEm±	3.76	4.91	1.04
CD at 5%	11.58	15.13	3.19
P value	0.00047	-	-

The flowering in the experimental plants commenced during 2nd and 3rd week of February and the fruit set was recorded in the month of March. As given in Table 2 the fruit retention in various treatments recorded significant variation. The maximum fruit retention was noticed in treatment T₃ (95.23%), which was significantly superior over T₇ (60.20%) and at par with all other treatments.

In control it took 103.33 days for harvesting after fruit set. The minimum number of days required for harvesting after fruit set were observed in treatment T₄ (72.66 days), which was significantly superior over all other treatments. It was followed by T₆ (88.00 days), which was at par with T₃ (88.67 days), T₁ (90.67 days), T₅ (91.33

days) and T_2 (93.6 days). All treatments could accelerate the harvesting of karonda over control however, the response varied significantly. Maximum advance of harvesting was recorded in T_4 (30.67 days) where KNO_3 and MKP were used. It was followed by T_6 (15.33 days) and T_3 (14.66 days) where paclobutrazol and urea + MKP were used, respectively. Where only KNO_3 was used, the acceleration was up to 12 days whereas, when only urea was used the advance recorded was upto 12.66 days. The nutrient requirement at various stages of each crop is different. The effective application of paclobutrazol has been reported as the soil drench through the root (Subhadrabandhu, Iamsu, & Kataoka, 1998). In the present study paclobutrazol was applied by foliar spray on leaves. Its foliar application have resulted into its less absorption in phloem (Voon, Pitakpaivan, & Tan, 1991). This may be the reason for limited response of paclobutrazol for acceleration of harvesting. In mango the foliar application of paclobutrazol helped to induce flowering (Tongumpai, Chantakulchan, Subhadrabandhu, & Ogata, 1996, Khader, 1992). Since all other nutrient treatments were foliar, the paclobutrazol was also applied through foliar spray. Treatments of potassium helped to reduce days required for harvesting due to 1.5 % KNO_3 in banana cv. Grand nain (Yelve, 2008). Foliar application of potassium hastened maturity in grapes (Arzumanov, 1966).

Table 3. Effect of foliar sprays of nutrients and paclobutrazol on fruit yield (kg/ha) in karonda cv. Konkan Bold

Treatment	Yield (kg)				
	Yield (kg/ha)	fruits harvested before rains		fruits harvested after rains	
		kg/ha	% of total	kg/ha	% of total
T_1 (Urea 1%) + (Urea 1%)	2260 ^{bc} (2260±180.28)	740 ^d (740±111.08)	33	1520 ^a (1520±261.55)	67
T_2 (Urea 1%) + (KNO_3 1%)	2430 ^b (2430±231.20)	1410 ^b (1410±155.44)	58	1020 ^c (1020±297.93)	42
T_3 (Urea 1%) + (MKP 0.5 %)	3040 ^a (3040±155.72)	1940 ^a (1940±169.15)	64	1100 ^{bc} (1100±269.02)	36
T_4 (KNO_3 1%) + (MKP 0.5 %)	1920 ^c (1920±120.86)	640 ^{de} (640±176.43)	33	1280 ^{ab} (1280±239.23)	67
T_5 (KNO_3 3%) + (KNO_3 3%)	1900 ^c (1900±165.10)	1060 ^c (1060±392.54)	56	840 ^c (840±175.48)	44
T_6 (PBZ 100 ppm)	1320 ^d (1320±169.19)	500 ^e (500±156.39)	38	820 ^c (820±210.18)	62
T_7 - Control	810 ^e (810±192.41)	180 ^f (180±71.55)	22	630 ^d (630±156.83)	78
Range	3040-810	1940-180	64-22	1520-630	78-36
SEm±	137.55	62.57	-	107.80	-
CD at 5%	423.84	192.79	-	332.16	-
P Value	-	-	0.007	-	0.001

As presented in Table 3, the total yield obtained in treatment T_3 was the maximum (3040 kg/ha) and significantly superior over all other treatments. It was followed by T_2 (2430 kg/ha) and T_1 (2260 kg/ha) which were at par with each other. The minimum total yield was noticed in T_7 (810 kg/ha) followed by T_6 (1320 kg/ha). The variation recorded for fruits harvested before rains was significant. Of the total yield of treatment T_3 (64%) fruits were harvested before rains. It was followed by T_2 , where (58%) fruits were harvested before rains. In treatment T_5 (56%) fruits were harvested before rains. In control only (22%) fruits could be harvested before rains whereas, (78%) fruits were harvested after rains. In T_1 and T_4 (67%) fruits were harvested after rains. In treatment T_3

minimum (36%) fruits were harvested after rains followed by T₂ (42%) and T₅ (44 %) through foliar application. In the present study the foliar application of nitrogen, phosphorus and potassium was advantageous for obtaining higher yield over control. Further, initial higher nitrogen followed by higher potassium and phosphorus helped to maximize yield in karonda. Singh, Sharma, Usha and Sagar (2002) reported that 0.8% urea was useful for obtaining highest yield (16.50 bunches/vine) as compared to control (14.00 bunches/vine) in grapes. Brahmachari, Kumar and Kumar (1997) observed that foliar sprays of potassium nitrate (1.5%) increased (39.36 kg/tree) the yield in guava as compared to control (29.69 kg/tree). Higher yield by use of paclobutrazol is reported in mango by Yeshitella et al. (2004).

Table 4. Effect of foliar sprays of nutrients and paclobutrazol on fruit length (cm), fruit weight (g) and fruit diameter in karonda fruit cv. Konkan Bold

Treatments	Fruit length (cm)			Fruit weight (g)			Diameter (cm)		
	1MAF	2MAF	At harvest	1MAF	2MAF	At harvest	1MAF	2MAF	At harvest
T ₁ (Urea 1%) + (Urea 1%)	2.3 (2.30±0.23)	2.81 ^{ab} (2.81±0.10)	2.93 ^{ab} (2.93±0.24)	6.75 ^a (6.75±0.16)	10.98 ^a (10.98±0.19)	13.02 ^b (13.02±2.23)	2.24 ^a (2.24±0.16)	2.52 ^{ab} (2.52±0.31)	2.75 ^a (2.75±0.14)
T ₂ (Urea 1%) + (KNO ₃ 1%)	2.4 (2.40±0.14)	2.90 ^{ab} (2.90±0.08)	2.93 ^{ab} (2.93±0.12)	6.85 ^a (6.85±0.17)	10.62 ^{ab} (10.62±0.43)	14.46 ^a (14.46±0.29)	2.20 ^a (2.20±0.11)	2.51 ^{abc} (2.51±0.15)	2.70 ^a (2.70±0.16)
T ₃ (Urea 1%) + (MKP 0.5 %)	2.37 (2.37±0.06)	2.87 ^{ab} (2.87±0.10)	2.92 ^{ab} (2.92±0.13)	6.81 ^a (6.81±0.21)	10.70 ^a (10.70±0.16)	13.12 ^{ab} (13.12±0.84)	2.21 ^a (2.21±0.11)	2.51 ^{abc} (2.51±0.23)	2.71 ^a (2.71±0.19)
T ₄ (KNO ₃ 1%) + (MKP 0.5 %)	2.35 (2.35±0.10)	2.85 ^{ab} (2.85±0.13)	2.89 ^{ab} (2.89±0.14)	6.87 ^a (6.87±0.07)	10.84 ^a (10.84±0.14)	14.20 ^a (14.20±0.59)	2.20 ^a (2.20±0.15)	2.47 ^{abc} (2.47±0.18)	2.69 ^a (2.69±0.12)
T ₅ (KNO ₃ 3%) + (KNO ₃ 3%)	2.41 (2.41±0.15)	3.00 ^a (3.00±0.12)	3.12 ^a (3.12±0.42)	6.90 ^a (6.90±0.21)	11.02 ^a (11.02±0.61)	14.51 ^a (14.51±1.89)	2.29 ^a (2.29±0.13)	2.53 ^a (2.53±0.27)	2.75 ^a (2.75±0.09)
T ₆ (PBZ 100ppm)	2.25 (2.25±0.05)	2.66 ^b (2.66±0.12)	2.72 ^b (2.72±0.08)	6.71 ^a (6.71±0.08)	10.05 ^{bc} (10.05±0.22)	12.32 ^b (12.32±0.29)	2.20 ^a (2.20±0.08)	2.38 ^{bc} (2.38±0.27)	2.64 ^a (2.64±0.22)
T ₇ - Control	2.21 (2.21±0.09)	2.50 ^b (2.50±0.17)	2.62 ^c (2.62±0.16)	6.09 ^b (6.09±0.16)	9.92 ^c (9.92±0.32)	12.10 ^b (12.10±0.17)	2.06 ^b (2.06±0.11)	2.10 ^c (2.10±0.12)	2.39 ^b (2.39±0.14)
Range	2.41-2.21	3.00-2.50	3.12-2.62	6.90-6.09	11.02-9.92	14.51-12.10	2.29-2.06	2.53-2.10	2.75-2.39
SEm±	0.07	0.07	0.09	0.09	0.19	0.56	0.03	0.13	0.06
CD at 5%	NS	0.21	0.27	0.29	0.59	1.72	0.1	0.41	0.2

Note: MAF – Month after fruit set.

The average fruit length one month after fruit set was 2.33cm which increased to 2.85 cm at harvest (Table 4). During all stages of growth it was minimum in T₇ followed by T₆. Fruit length was maximum in T₅ at all stages of growth. It was at par with T₁, T₂, T₃ and T₄ upto 2 MAF. At harvest T₅ (3.12 cm) was at par with T₁ (2.93 cm), T₂ (2.93 cm) and T₃ (2.92 cm) and significantly superior over T₄ (2.89cm). The fruit weight recorded by control fruits was minimum at all stages of growth upto harvesting. It was followed by T₆. The maximum fruit weight was recorded in T₅ (11.02 g) which was at par with T₁ (10.98 g), T₄ (10.84 g), T₃ (10.70g) and T₂ (10.62 g) upto two MAF. At harvest T₅ (14.51 g) was at par with T₂ (14.46 g) and T₃ (13.12 g) and significantly superior over all other treatments. The diameter of fruits observed in T₅ was highest throughout the period of growth till harvest. It was significantly superior over control and at par with all other treatments. Potassium increases the capacity to synthesize starch (Singh, 2006). Dutta (2004) obtained the highest fruit weight (99.0 g) by the application of 2 per cent KNO₃ spray than control (92.50 g) in guava cv. Sardar under West Bengal conditions. Thus foliar application of nitrogen, phosphorus and potassium was beneficial to improve the physical parameter of karonda fruits over control.

Table 5. Effect of foliar sprays of nutrients and paclobutrazol on TSS ($^{\circ}$ B), Acidity (%), reducing sugar (%), non-reducing (%) and total sugar (%) in karonda fruit cv. Konkan Bold

Treatments	TSS ($^{\circ}$ B)			Acidity (%)			Reducing sugar (%)			Total sugar (%)		
	1MAF	2MAF	At harvest	1MAF	2MAF	At harvest	1MAF	2MAF	At harvest	1MAF	2MAF	At harvest
T ₁ (Urea 1%) +	5.58 ^a	12.13 ^c	17.83 ^c	2.65 ^a	1.73 ^a	0.85 ^a	3.26 ^a	3.96 ^b	8.50 ^a	5.15 ^c	6.60 ^c	10.41 ^b
(Urea 1%)	(5.58±0.47)	(12.13±0.18)	(17.83±0.28)	(2.65±0.19)	(1.73±0.17)	(0.85±0.05)	(3.26±0.07)	(3.96±0.21)	(8.50±0.21)	(5.15±0.15)	(6.60±0.11)	(10.41±0.21)
T ₂ (Urea 1%) +	5.65 ^a	12.57 ^b	18.13 ^{ab}	2.71 ^a	1.78 ^a	0.87 ^a	3.28 ^a	4.11 ^b	8.74 ^a	5.19 ^{bc}	6.72 ^{bc}	10.70 ^a
(KNO ₃ 1%)	(5.65±0.29)	(12.57±0.29)	(18.13±0.16)	(2.71±0.19)	(1.78±0.13)	(0.87±0.10)	(3.28±0.95)	(4.11±0.17)	(8.74±0.10)	(5.19±0.10)	(6.72±0.15)	(10.70±0.16)
T ₃ (Urea 1%) +	5.67 ^a	12.83 ^a	18.33 ^a	2.69 ^a	1.76 ^a	0.84 ^a	3.34 ^a	5.12 ^a	8.85 ^a	5.87 ^a	7.33 ^a	10.90 ^a
(MKP 0.5 %)	(5.67±0.19)	(12.83±0.09)	(18.33±0.23)	(2.69±0.15)	(1.76±0.11)	(0.84±0.05)	(3.34±0.10)	(5.12±0.79)	(8.85±0.40)	(5.87±0.08)	(7.33±0.18)	(10.90±0.09)
T ₄ (KNO ₃ 1%) +	5.64 ^a	12.80 ^a	18.00 ^{bc}	2.58 ^{ab}	1.78 ^a	0.77 ^b	3.28 ^a	4.94 ^a	8.73 ^a	5.21 ^b	6.76 ^b	10.81 ^a
(MKP 0.5 %)	(5.64±0.27)	(12.80±0.15)	(18.00±0.21)	(2.58±0.09)	(1.78±0.08)	(0.77±0.06)	(3.28±0.08)	(4.94±0.11)	(8.73±0.09)	(5.21±0.09)	(6.76±0.13)	(10.81±0.11)
T ₅ (KNO ₃ 3%) +	5.20 ^b	12.60 ^b	18.10 ^{abc}	2.69 ^a	1.71 ^a	0.83 ^{ab}	3.25 ^a	5.15 ^a	8.64 ^a	5.32 ^b	6.87 ^b	10.70 ^a
(KNO ₃ 3%)	(5.20±0.16)	(12.60±0.14)	(18.10±0.11)	(2.69±0.10)	(1.71±0.07)	(0.83±0.06)	(3.25±0.08)	(5.15±0.09)	(8.64±0.15)	(5.32±0.13)	(6.87±0.09)	(10.70±0.17)
T ₆ (PBZ 100ppm)	4.64 ^c	10.02 ^d	15.19 ^d	2.49 ^b	1.68 ^{ab}	0.70 ^c	2.38 ^b	3.55 ^{bc}	7.93 ^b	4.64 ^d	5.94 ^d	9.16 ^c
	(4.64±0.29)	(10.02±0.31)	(15.19±0.08)	(2.49±0.09)	(1.68±0.03)	(0.70±0.05)	(2.38±0.16)	(3.55±0.28)	(7.93±0.15)	(4.64±0.08)	(5.94±0.21)	(9.16±0.68)
T ₇ - Control	4.61 ^d	9.94 ^d	15.21 ^d	2.46 ^b	1.57 ^b	0.68 ^c	2.29 ^b	3.41 ^c	7.85 ^b	4.52 ^d	5.72 ^d	9.14 ^c
	(4.61±0.72)	(9.94±0.13)	(15.21±0.32)	(2.46±0.12)	(1.57±0.12)	(0.68±0.06)	(2.29±0.12)	(3.41±0.13)	(7.85±0.10)	(4.52±0.13)	(5.72±0.13)	(9.14±0.11)
Range	5.67-4.61	12.83-9.94	18.33-15.19	2.71-2.46	1.78-1.57	0.87-0.68	3.34-2.29	5.15-3.41	8.85-7.85	5.87-4.52	7.33-5.72	10.90-9.14
SEm±	0.11	0.05	0.09	0.04	0.04	0.02	0.24	0.21	0.12	0.06	0.05	0.07
CD at 5%	0.35	0.15	0.28	0.13	0.13	0.06	0.74	0.63	0.38	0.17	0.15	0.22

Note: MAF – Month after fruit set.

The TSS varied significantly for all treatments (Table 5). Treatment T₃ recorded highest TSS at 1 MAF (5.67 $^{\circ}$ Brix), 2 MAF (12.83 $^{\circ}$ Brix) and at harvest (18.33 $^{\circ}$ Brix), which was at par with T₂ (18.13 $^{\circ}$ Brix) and T₅ (18.10 $^{\circ}$ Brix) at harvest. The lowest TSS was recorded in T₇ at all stages of growth followed by T₆. The acidity was highest in T₂ at all stages of growth whereas, in treatment T₇ it was the lowest. The reducing and total sugars were maximum in treatment T₃ and minimum in treatment T₇ at all stages of growth. Importantly the foliar nutrient treatments improved magnitude of quality parameters. Potassium enrich quality of fruits. Nitrogen and phosphorus play complimentary role in fruit development. Foliar application of 1 per cent urea and KNO₃ resulted in decrease in fruit acidity (0.30 and 0.29%, respectively) over control (0.33%) in mango cv. Alphonso under Tamil Nadu conditions (Vijayalakshmi & Srinivasan, 1998).

4. Conclusion

Thus, the experiment concluded that paclobutrazol and post flowering foliar sprays of nutrients accelerated harvesting, improved yield and quality of karonda. Among all the treatments T₃ (Urea 1% + MKP 0.5%) was the best, which resulted in highest fruit retention (95.20%), maximum fruit yield before rains (64%), minimum fruit yield after rains (36%) and best quality of fruits with highest TSS (18.33 $^{\circ}$ Brix), reducing sugar (8.85%) & total sugar (10.90%).

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