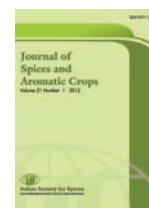


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Effect of post flowering foliar sprays of nutrients on fruit growth of kokum (*Garcinia indica* Choisy)

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Abstract

A study was undertaken at Dapoli (Maharashtra) to find out the effect of application of post-flowering foliar nutrients on growth of kokum (*Garcinia indica* Choisy) fruits. Various concentrations and combinations of urea 1.0%, potassium nitrate 3.0%, monopotassium phosphate 0.5% and 19 N:19 P:19 K (1.0%) were applied at fruit set and repeated 20 days after fruit (DAF) set. The results indicated that weight of fruit increased consistently up to 90 days of fruit set and decreased slightly at harvest irrespective of treatments. The increase in fruit length and fruit circumference was linear till harvest. All foliar nutrient treatments improved the growth rate over control with respect to fruit weight, fruit length and fruit circumference at all stages of fruit growth. T₄ [potassium nitrate 3.0% twice], T₅ [potassium nitrate 3.0% + monopotassium phosphate 0.5%] and T₆ [19 N: 19 P:19 K (1.0%) twice] were at par with each other and recorded significantly higher yield over control. Among the treatments T₂ [Urea 1.0% + potassium nitrate 3.0%] was the best for improvement in fruit weight and fruit circumference of kokum fruit. All foliar nutrient sprays improved the quality of kokum fruit with respect to total soluble solids, acidity, ascorbic acid and sugar content. Among the treatments, T₄ and T₅ were at par with each other and significantly improved acidity and sugar content.

Keywords: foliar nutrients, fruit growth, *Garcinia indica* Choisy, kokum, quality

Introduction

Limited information is available on kokum (*Garcinia indica* Choisy) with respect to improvement in fruit quality. An attempt was therefore made to study the effect of application of post flowering foliar nutrients on growth and quality of fruits of kokum.

Materials and methods

The trial was conducted at the farm of Department of Horticulture, College of

Agriculture, Dapoli (Maharashtra) for two consecutive years during 2008 and 2009. Thirty year old bearing seedling kokum plants planted at 8 m × 5 m spacing, under uniform recommended management practices were selected for the trial. The trial was conducted in a randomized block design with nine treatments of post flowering foliar sprays and three replications with a unit of two plants per treatment per replication (Table 1).

The fruits were randomly marked at fruit set

Table 1. Treatment details of post flowering foliar sprays on kokum

Treatment	At fruit set	20 days after fruit set
T ₁	Urea 1.0%	Urea 1.0%
T ₂	Urea 1.0%	Potassium nitrate 3.0%
T ₃	Urea 1.0%	Monopotassium phosphate 0.5%
T ₄	Potassium nitrate 3.0%	Potassium nitrate 3.0%
T ₅	Potassium nitrate 3.0%	Monopotassium phosphate 0.5%
T ₆	19 N:19 P:19 K 1.0%	19 N:19 P:19 K 1.0%
T ₇	19 N:19 P:19 K 1.0%	Potassium nitrate 3.0%
T ₈	19 N:19 P:19 K 1.0%	Monopotassium phosphate 0.5%
T ₉	Control (No spray)	Control (No spray)

and 10 fruits were randomly selected per treatment per replication to record the fruit weight, fruit length, fruit circumference, total soluble solids (TSS), acidity, ascorbic acid, reducing sugar, non reducing sugar and total sugar contents. These observations were recorded at 30 days interval from fruit set till harvest. The observations were recorded during both the years and statistical analysis was done as per the method suggested by Panse & Sukhatme (1997). Relative growth rate (RGR) was computed for fruit weight, fruit length and fruit circumference and for chemical composition, per cent increase/decrease was determined by the formula suggested by Blackman (1919).

Results and discussion

The weight of fruits in all treatments (T₁ to T₈) was higher than that of control at all stages of growth and was highest in treatment T₂ [urea 1.0% + potassium nitrate 3.0%] (Table 2). At 30 DAF, T₁ was at par with T₅ [potassium nitrate 3.0% + monopotassium phosphate 0.5%]; whereas at 60 DAF, T₂, T₁ [urea 1.0% twice] and T₈ [19 N:19 P:19 K 1.0% + monopotassium phosphate 0.5%] were at par. At 90 DAF, T₂ was at par with T₃ and significantly superior over other treatments. At harvest, T₂ was significantly superior over rest of treatments followed by T₃ [urea 1.0% + monopotassium phosphate 0.5%] which was at par with T₆ [19 N:19 P:19 K 1.0% twice]. The fruit weight increased from fruit set to 90 DAF and reduced from 90 DAF to harvest in all treatments, but it was improved by all foliar nutrient sprays at

all stages of fruit growth than that of control (Fig. 1). Nitrogen, phosphorous and potassium are major elements which play pivotal role in the growth and development of fruits. The marginal decrease in fruit weight at harvest has been earlier reported in kokum (Shinde 2007). Fruit length recorded a linear increase throughout the period of fruit growth till harvest (Table 2). Fruit length recorded in all the foliar treatments was higher over control at all stages of fruit growth and was highest in treatment T₅ at 30 DAF (2.25 cm) and 60 DAF (3.05 cm); whereas at 90 DAF and at harvest it was highest in T₂ (3.52 cm and 3.79 cm

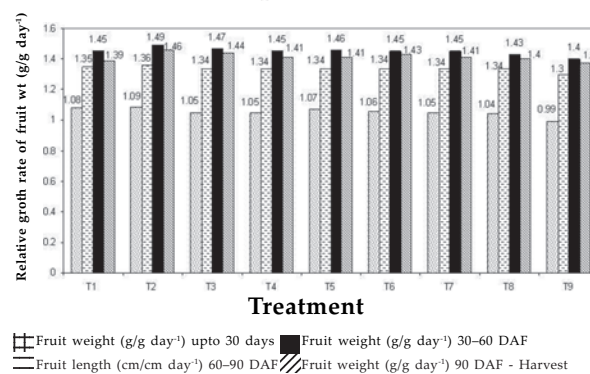


Fig. 1. Effect of post foliar nutrient sprays on weight of kokum fruit (Pooled data of 2008–09) (DAF=Days after fruitset)

respectively). At 30 DAF, T₅ was at par with T₄ [potassium nitrate 3.0% twice] and T₂ whereas at 60 DAF it was on par with T₄. At 90 DAF and at harvest T₂ was at par with T₄, T₅, T₃ and T₆. The relative growth rate of fruit length (Fig. 2) exhibited a linear fashion and increased during 30–60 DAF and 60–90 DAF and was at

Table 1. Effect of post-foliar nutrient sprays on fruit weight, fruit length and fruit circumference of kokum fruit at different growth stages (Pooled data of 2008–2009)

Treatment	Fruit weight (g)						Fruit length (cm)						Fruit circumference (cm)						Yield (kg/tree)
	30		90		At		30		90		At		30		90		At		
	DAF	DAF harvest	DAF	DAF harvest	DAF	DAF harvest	DAF	DAF harvest	DAF	DAF harvest	DAF	DAF harvest	DAF	DAF harvest	DAF	DAF harvest	DAF	DAF harvest	
T ₁ : Urea 1.0%	11.70	24.15	31.02	27.32	2.13	2.68	3.31	3.59	6.72	10.97	11.87	12.78	54.28						
T ₂ : Urea 1.0% + KNO ₃ 3.0%	11.87	25.14	34.10	32.23	2.17	2.76	3.52	3.79	6.70	11.14	12.12	13.12	56.90						
T ₃ : Urea 1.0% + MPP 0.5%	10.92	23.63	32.63	30.85	2.16	2.91	3.48	3.71	6.83	10.83	11.69	12.77	59.08						
T ₄ : KNO ₃ 3.0%	10.86	23.86	31.07	28.61	2.19	2.97	3.50	3.73	6.98	10.51	11.65	12.30	73.20						
T ₅ : KNO ₃ 3.0% + MPP 0.5%	11.29	23.49	31.88	28.95	2.25	3.05	3.50	3.73	7.75	10.51	11.47	12.46	70.54						
T ₆ : 19 N:19 P:19 K (1.0%)	11.13	23.52	31.40	30.00	2.15	2.93	3.41	3.71	7.08	10.28	11.30	12.16	64.71						
T ₇ : 19 N:19 P:19 K (1.0%) + KNO ₃ 3.0%	10.81	23.48	31.44	28.61	2.14	2.88	3.31	3.57	6.80	10.09	11.51	11.88	56.18						
T ₈ : 19 N:19 P:19 K (1.0%) + MPP 0.5%	10.73	23.94	29.60	27.95	2.09	2.81	3.26	3.62	6.70	10.06	11.15	12.02	57.93						
T ₉ : Control	9.40	21.72	27.76	26.29	2.01	2.58	3.16	3.47	6.57	9.91	10.60	11.54	46.81						
Mean	10.97	23.66	31.21	28.98	2.14	3.50	3.38	3.66	6.90	10.48	11.48	12.34	59.96						
SE _m ±	0.18	0.41	0.62	0.41	0.02	0.02	0.05	0.05	0.19	0.08	0.06	0.04	4.40						
CD (P=0.05%)	0.55	1.24	1.88	1.25	0.08	0.08	0.17	0.16	0.58	0.24	0.18	0.14	13.21						

DAF=Days after fruit set; MPP=Mono potassium phosphate; KNO₃=Potassium nitrate**Table 2.** Effect of post-foliar nutrient sprays on TSS, acidity and ascorbic acid content of kokum fruit at different growth stages (Pooled data of 2008–2009)

Treatment	TSS (° Brix)						Acidity (%)						Ascorbic acid (mg/100 g)					
	30		90		At		30		90		At		30		90		At	
	DAF	DAF harvest	DAF	DAF harvest	DAF	DAF harvest	DAF	DAF harvest	DAF	DAF harvest	DAF	DAF harvest	DAF	DAF harvest	DAF	DAF harvest	DAF	DAF harvest
T ₁ : Urea 1.0%	12.68	13.58	12.96	13.91	3.96	4.40	3.41	3.96	25.36	20.09	14.32	9.12						
T ₂ : Urea 1.0% + KNO ₃ 3.0%	12.68	13.64	13.17	14.28	3.98	4.47	3.50	3.90	25.86	19.97	14.86	9.02						
T ₃ : Urea 1.0% + MPP 0.5%	12.85	13.90	13.33	14.10	3.95	4.39	3.48	3.77	27.35	20.01	16.50	8.74						
T ₄ : KNO ₃ 3.0%	12.63	14.19	13.92	15.29	4.32	4.71	3.87	4.21	27.75	22.16	17.09	9.45						
T ₅ : KNO ₃ 3.0% + MPP 0.5%	13.00	14.27	13.49	15.00	4.14	4.58	3.66	4.07	28.90	23.35	18.64	9.40						
T ₆ : 19 N:19 P:19 K (1.0%)	12.74	13.86	13.40	14.67	4.09	4.47	3.48	3.91	27.87	21.15	16.12	9.11						
T ₇ : 19 N:19 P:19 K (1.0%) + KNO ₃ 3.0%	12.71	13.76	13.13	14.63	4.08	4.50	3.63	3.96	28.04	21.16	15.22	9.35						
T ₈ : 19 N:19 P:19 K (1.0%) + MPP 0.5%	12.58	13.66	12.93	14.15	3.87	4.43	3.55	3.97	26.72	20.02	14.85	8.82						
T ₉ : Control	12.44	13.16	12.52	13.68	3.75	4.17	3.13	3.49	24.02	18.41	12.68	8.10						
Mean	12.70	13.78	13.21	14.41	4.01	4.46	3.52	3.92	26.87	20.70	15.71	9.01						
SE _m ±	0.05	0.04	0.05	0.07	0.05	0.05	0.06	0.04	0.37	0.50	0.34	0.08						
CD (P=0.05%)	0.16	0.13	0.17	0.21	0.16	0.17	0.18	0.14	1.13	1.51	1.03	0.25						

DAF=Days after fruit set; MPP=Mono potassium phosphate; KNO₃=Potassium nitrate; TSS=Total soluble solids

its peak from 90 DAF till harvest in all treatments (Fig. 2). In treatments T₁ to T₈ where foliar nutrients were used, it was higher than that of control.

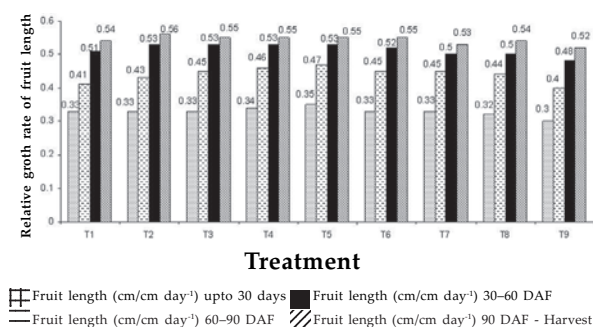


Fig. 2. Effect of post foliar nutrient sprays on fruit length of kokum (Pooled data of 2008–09) (DAF=Days after fruitset)

Fruit circumference at 30 DAF was the maximum in T₅ (7.75 cm) which was significantly superior over other treatments. T₂ Recorded maximum fruit circumference at 60 DAF, 90 DAF and at harvest (11.14 cm, 12.12 cm and 13.12 cm respectively). At 60 DAF it was at par with T₁ (10.97 cm) whereas at 90 DAF and at harvest it was significantly superior over all other treatments. The increase in fruit circumference was also similar to that of fruit length (Fig. 3). All foliar nutrients improved yield of kokum over control, however, T₄ (73.2

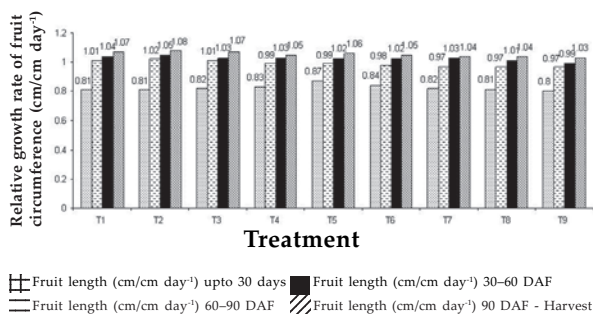


Fig. 3. Effect of post foliar nutrient sprays on fruit circumference of kokum (Pooled data of 2008–09) (DAF=Days after fruitset)

kg tree⁻¹), T₅ (70.54 kg tree⁻¹) and T₆ (64.71 kg tree⁻¹) were at par with each other and recorded significantly higher yield over control (46.81 kg tree⁻¹). All remaining treatments were on par with each other for yield.

TSS was lowest among all treatments at all

stages of growth in control (Table 2). In treatments T₁ to T₈ where foliar nutrients were used, TSS was greater than control and was highest at harvest (15.29° B). At 30 DAF, T₅ and T₃ were at par with each other whereas at 60 DAF, T₅ and T₄ were at par with each other. At 90 DAF and at harvest TSS recorded by T₅ was significantly superior to all other treatments. A decrease in TSS from 60–90 DAF in kokum fruits has been reported earlier by Raorane (2003) and Shinde (2007).

Acidity at all stages of growth was significantly superior in treatment T₄ except at harvest where it was at par with T₅. It was lowest at all stages in control. Reduction in acidity from 60–90 DAF in kokum fruits has also been earlier reported by Raorane (2003) and Shinde (2007). Continuous decrease in ascorbic acid content from 30 DAF till harvest was recorded in all treatments and lowest quantity was recorded in control at all stages of growth among all treatments. The quantity of ascorbic acid recorded in T₅ was highest at 30 DAF (28.90 mg 100⁻¹g), 60 DAF (23.35 mg 100⁻¹g) and at 90 DAF (18.64 mg 100⁻¹g) however, it was at par with T₆ and T₇ at 30 DAF and with T₄ at 60 DAF and at harvest. Generally the highest ascorbic acid content is observed in the fruits just after fruit set and its concentration decrease with fruit development (Shinde 2007).

Reducing, non reducing and total sugar content showed a linear increasing trend from fruit set till harvest (Table 3). The sugar content in all foliar nutrient treatments was higher than that of control. At 30 DAF the highest reducing sugar were found in T₅ which was at par with T₄ and T₆. Treatments T₄ and T₅ recorded maximum reducing sugars at 60 DAF and 90 DAF respectively, which were significantly superior over other treatments; whereas at harvest both these treatments were at par. The non reducing sugar in T₅, T₃ and T₄ was at par with each other at 30 DAF. Treatments T₅ and T₃ recorded maximum reducing sugar at 60 DAF and 90 DAF respectively, which were significantly superior

Table 3. Effect of post-foliar nutrient sprays on reducing sugar, non reducing sugar and total sugar content of kokum fruit at different growth stages (Pooled data of 2008–2009)

Treatment	Reducing sugar (%)			Non reducing sugar (%)			Total sugar (%)					
	30	60	90	At harvest	30	60	90	At harvest	30	60	90	At harvest
T ₁ : Urea 1.0%	2.44	3.07	3.70	4.73	3.22	3.99	4.55	4.84	5.66	7.06	8.24	9.57
T ₂ : Urea 1.0% + KNO ₃ 3.0%	2.58	2.98	3.85	4.62	3.40	4.20	4.55	4.78	5.98	7.18	8.40	9.40
T ₃ : Urea 1.0% + MPP 0.5%	2.54	3.14	3.73	4.73	3.63	4.11	5.08	4.99	6.17	7.25	8.81	9.72
T ₄ : KNO ₃ 3.0%	2.73	3.53	4.17	5.23	3.68	3.97	4.64	5.28	6.41	7.50	8.80	10.51
T ₅ : KNO ₃ 3.0% + MPP 0.5%	2.81	3.23	4.35	5.37	3.65	4.37	4.77	5.22	6.46	7.60	9.12	10.59
T ₆ : 19 N:19 P:19 K (1.0%)	2.63	3.04	3.76	5.08	3.30	3.87	4.36	4.69	5.93	6.91	8.12	9.76
T ₇ : 19 N:19 P:19 K (1.0%) + KNO ₃ 3.0%	2.54	2.95	3.81	4.98	3.21	3.86	4.19	4.68	5.76	6.81	8.00	9.66
T ₈ : 19 N:19 P:19 K (1.0%) + MPP 0.5%	2.54	2.92	3.65	4.93	3.05	3.69	4.00	4.65	5.59	6.64	7.66	9.57
T ₉ : Control	2.22	2.78	3.29	4.25	2.97	3.25	3.82	4.42	5.19	6.03	7.11	8.67
Mean	2.56	3.07	3.81	4.88	3.34	3.92	4.44	4.84	5.90	7.00	8.25	9.72
SE _m ±	0.06	0.03	0.04	0.07	0.05	0.05	0.06	0.08	0.09	0.05	0.06	0.10
CD (P=0.05%)	0.19	0.10	0.12	0.21	0.15	0.15	0.18	0.26	0.27	0.17	0.19	0.30

DAF=Days after fruit set; MPP=Mono potassium phosphate; KNO₃=Potassium nitrate

over other treatments. The non reducing sugar content recorded in treatments T₅ and T₄ were at par with each other and significantly superior over rest of treatments at harvest. The total sugar noticed in T₅ and T₄ were at par with each other and significantly superior over rest of treatments at 30 DAF, 60 DAF and at harvest.

Thus the study indicated that all foliar treatments improved the fruit weight, fruit length and fruit circumference at all stages of fruit growth which further led to improved yield. T₄ [potassium nitrate 3.0% twice], T₅ [potassium nitrate 3.0% + monopotassium phosphate 0.5%] and T₆ [19 N:19 P:19 K (1.0%) twice] were at par with each other and recorded significantly higher yield over control. Among the treatments, T₂ [Urea 1.0% + potassium nitrate 3.0%] was the best for improvement in fruit weight and fruit circumference of kokum fruit. The foliar nutrients also improved quality of kokum. Among treatments, T₄ [potassium nitrate 3.0% twice] and T₅ [potassium nitrate 3.0% + monopotassium phosphate 0.5%] were at par with each other and significantly improved acidity and sugar content.

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