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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. T_4 [potassium nitrate 3.0% twice], T_5 [potassium nitrate 3.0% + monopotassium phosphate 0.5%] and T_6 [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 T_2 [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, T_4 and T_5 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 (T_1 to T_8) was higher than that of control at all stages of growth and was highest in treatment T_2 [urea 1.0% + potassium nitrate 3.0%] (Table 2). At 30 DAF, T_1 was at par with T_5 [potassium nitrate 3.0% + monopotassium phosphate 0.5%]; where as at 60 DAF, T_2, T_1 [urea 1.0% twice)] and T_8 [19 N:19 P:19 K 1.0% + monopotassium phosphate 0.5%] were at par. At 90 DAF, T_2 was at par with T_3 and significantly superior over other treatments. At harvest, T_2 was significantly superior over rest of treatments followed by T_3 [urea 1.0% + monopotassium phosphate 0.5%] which was at par with T_6 [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 T_5 at 30 DAF (2.25 cm) and 60 DAF (3.05 cm); whereas at 90 DAF and at harvest it was highest in T_2 (3.52 cm and 3.79 cm

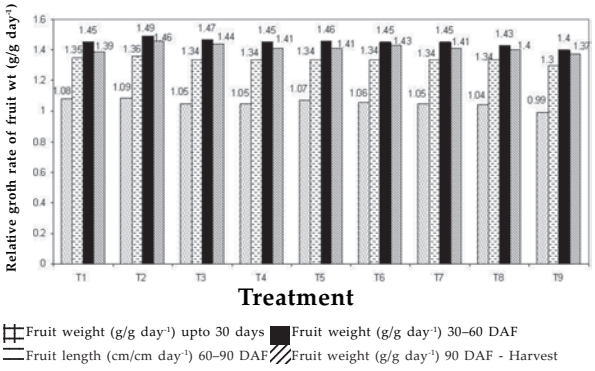

Fig. 1. Effect of post foliar nutrient sprays on weight of kokum fruit (Pooled data of 2008–09) (DAF=Days after fruitset)

respectively). At 30 DAF, T_5 was at par with T_4 [potassium nitrate 3.0% twice] and T_2 whereas at 60 DAF it was on par with T_4. At 90 DAF and at harvest T_2 was at par with T_4, T_5, T_3 and T_6. 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
	30 DAF	60 DAF	90 DAF	At harvest	30 DAF	60 DAF	90 DAF	At harvest	30 DAF	60 DAF	90 DAF	At harvest	(kg/tree)
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
$SE_m\pm$	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; KNO_3=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 DAF	60 DAF	90 DAF	At harvest	30 DAF	60 DAF	90 DAF	At harvest	30 DAF	60 DAF	90 DAF	At 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
$SE_m\pm$	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; KNO_3=Potassium nitrate; TSS=Total soluble solids

its peak from 90 DAF till harvest in all treatments (Fig. 2). In treatments T_1 to T_8 where foliar nutrients were used, it was higher than that of control.

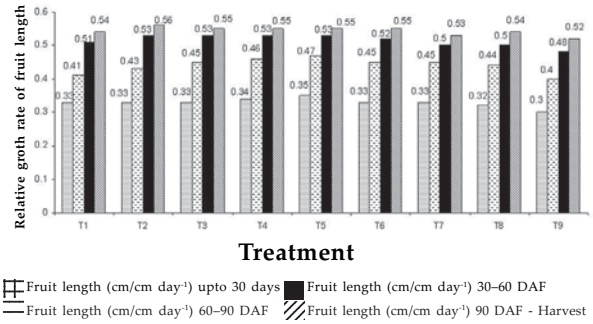

Fig 2. Effect of post foliar nutrient sprays on fruit length of kokum (Pooled data of 2008–09) (DAF=Days after fruitset)

Fruit circumference at 30 DAF was the maximum in T_5 (7.75 cm) which was significantly superior over other treatments. T_2 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 T_1 (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, T_4 (73.2

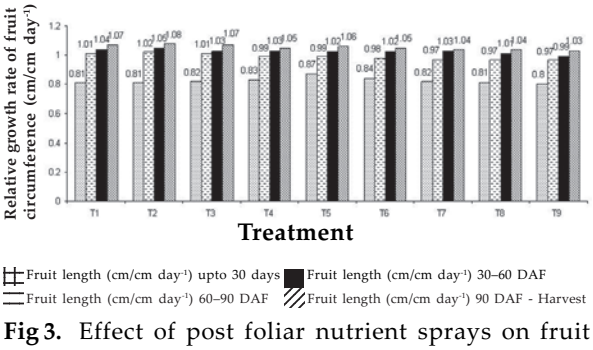

Fig 3. Effect of post foliar nutrient sprays on fruit circumference of kokum (Pooled data of 2008–09) (DAF=Days after fruitset)

kg tree^{-1}), T_5 (70.54 kg tree^{-1}) and T_6 (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 T_1 to T_8 where foliar nutrients were used, TSS was greater than control and was highest at harvest (15.29° B). At 30 DAF, T_5 and T_3 were at par with each other whereas at 60 DAF, T_5 and T_4 were at par with each other. At 90 DAF and at harvest TSS recorded by T_5 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 T_4 except at harvest where it was at par with T_5. 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 T_5 was highest at 30 DAF (28.90 mg 100^{-1}g), 60 DAF (23.35 mg 100^{-1}g) and at 90 DAF (18.64 mg 100^{-1}g) however, it was at par with T_6 and T_7 at 30 DAF and with T_4 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 T_5 which was at par with T_4 and T_6. Treatments T_4 and T_5 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 T_5, T_3 and T_4 was at par with each other at 30 DAF. Treatments T_5 and T_3 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 DAF	60 DAF	90 DAF	At harvest	30 DAF	60 DAF	90 DAF	At harvest	30 DAF	60 DAF	90 DAF	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
S E_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; KNO_3=Potassium nitrate

over other treatments. The non reducing sugar content recorded in treatments T_5 and T_4 were at par with each other and significantly superior over rest of treatments at harvest. The total sugar noticed in T_5 and T_4 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. T_4 [potassium nitrate 3.0% twice], T_5 [potassium nitrate 3.0% + monopotassium phosphate 0.5%] and T_6 [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, T_2 [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, T_4 [potassium nitrate 3.0% twice] and T_5 [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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