



P-ISSN: 2349-8528

E-ISSN: 2321-4902

www.chemijournal.com

IJCS 2020; 8(3): 2126-2129

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Received: 12-03-2020

Accepted: 16-04-2020

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Effect of different levels of NPK fertilizers on yield, and biochemical properties of inflorescence sap of coconut

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DOI: <https://doi.org/10.22271/chemi.2020.v8.i3ad.9524>**Abstract**

A field experiment was carried out to study the influence of nutrition to coconut palms as different levels of NPK fertilizers viz., recommended dose of fertilizers (0.5: 0.32:1.20 kg NPK/Palm), 125% of recommended dose, 150% of recommended dose and 175% of recommended dose on yield, sap production duration and biochemical properties of coconut inflorescence sap. The experiment was laid out in RBD on west coast tall variety under rainfed condition. The results indicated that the yield of coconut inflorescence sap was 134% higher in the treatment receiving 175% POP recommendation compared to normal recommendation. The treatment receiving the highest level of nutrients, i.e. 175% of POP recommendation recorded significantly higher values for biochemical properties such as pH, electrolyte concentration, reducing sugars, non-reducing sugars, total sugar, alcohol, phenol and vitamin-C content of coconut inflorescence sap. Hence it can be concluded that higher yields and better quality of coconut inflorescence sap can be achieved by the application of an additional 75% of NPK fertilizers over and above the recommended dose of fertilizers for nut yielding coconut palms.

Keywords: Coconut inflorescence sap, nutrition, yield, biochemical properties**Introduction**

Coconut inflorescence sap (CIS) is extracted by a method called tapping which involves selective bleeding of unopened coconut inflorescence which is a traditional practice in all coconut growing countries. The exuding sap is a sweet translucent juice, oyster white in colour with high nutritive value. It is a rich source of reducing and non reducing sugars with plenty of minerals and vitamins. It is also a good source of iron, phosphorous and ascorbic acid. The most significant characteristic of coconut inflorescence sap is its low glycemic index an indication of the extent of sugar absorbed into the blood which makes it suitable even for consumption for diabetic patients (Manohar *et al.*, 2007) [8]. In recent times there is a huge global demand for low GI sugars while its availability is limited. CIS which is a natural source of low GI sugars can fill up this gap. The available nutrient content of soil and tissue nutrient concentration influences the quantity and quality of coconut inflorescence sap. It is important to identify the nutrients such as N, P, K, Ca, Mg, S, Fe, Mn, Zn, Cu, Na and Cl content of soil and tissue that influence CIS output and its nutritional qualities. The nutrient requirement for coconut palms being tapped is much higher than palms maintained for nut production. The response of tapping palms to higher doses of fertilizers has to be evaluated. It will be helpful in developing specific nutrient management plans for tapping coconut palms. Hence, the present study was undertaken to study the influence of nutrition on yield and biochemical properties of coconut inflorescence sap.

Materials and Methods

The study was conducted in Instructional farm, College of Agriculture, Vellayani during 2014-2016. Coconut palms of same age and morphological characters were selected for the study. The experiment was laid out in RBD with five replications. There were 4 treatments namely POP recommendation (T₁), 125% POP Recommendation (T₂), 150% POP Recommendation (T₃) and 175% POP Recommendation (T₄). The other cultural practices were adopted as per POP, KAU, 2011. The palms were started tapping 11 months after treatment application. Fully emerged unopened bunches were selected for tapping.

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The bunch was tied at many places to prevent opening of inflorescence and facilitate sap flow. The first cut was made on the same day of tying or within next four days. After the first cut, every day the cut surface was opened twice by slicing the cut edge again and the bunch is delicately beaten or tapped twice a day to stimulate flow of sap. The flow started 8 to 12 days after the first cut was made and the flow continues for 40 to 60 days. Slicing the cut edge and tapping were repeated every day. The sap was collected in a plastic container tied to the bunch. The sap volume of each harvesting was measured with a measuring cylinder 21st day after starting of tapping. The sap production duration was the number of days during which it produced the sap. This was assessed by counting days, since the first bleeding until the end of the sap flow from the spathe. During morning, Samples were collected in plastic bottles by keeping for two hours on the bunch. The collected samples were immediately stored in refrigerator and Biochemical analysis was conducted to estimate pH, electrolyte concentration, reducing sugars, non-reducing sugars, total sugar, alcohol, phenol and vitamin-C content in sap. The pH of sap was measured using electronic pH meter (Saini *et al.*, 2001) [17]. The total electrolyte concentration of sap was measured by using Conductivity Bridge (Jackson, 1958) [4]. The total sugar content of sap was estimated as per the procedure outlined by (Mc Cready *et al.*, 1950) [10]. The estimation of reducing sugars in sap was done by dinitro salicylic acid (DNS) method (Somogyi, 1952) [19]. The observation under total sugars and reducing sugars were used for calculating non reducing sugars based on the procedure suggested by Ranganna (1977) [15] and expressed as percent on fresh weight basis. The vitamin-c content of sap was estimated by the volumetric method (Sadasivam and Manickam, 2008) [16]. Alcohol content of sap was estimated by titration method using potassium dichromate and sodium thiosulphate (William and Darwin, 1950) [22] Phenols content was estimated by Folin-Ciocalteu method (Mayr *et al.*, 1995) [9]. The data obtained were analyzed statistically and significance was calculated at ($p < 0.05$) levels of probability.

Results and Discussion

Influence of nutrition (Different Levels of NPK Fertilizers) on yield, sap production duration and biochemical properties of coconut inflorescence sap are presented in Table 1.

CIS Yield

The yield of coconut inflorescence sap was significantly influenced by the application of increased levels of NPK fertilizer. The T₄ (175% POP Recommendation) recorded the highest CIS yield (3.32 l day⁻¹) which was significantly higher than all the treatments. This was followed by T₃ (2.78 l day⁻¹) which was significantly higher than the remaining treatments. T₂ recorded CIS yield of 2.32 l day⁻¹ which was significantly higher than T₁ (1.42 l day⁻¹). The positive trend of results for coconut inflorescence sap yield obtained for higher levels of NPK fertilization is quite reasonable because there was a significant increase in available status of N, P and K in soil as well as a positive but insignificant increase in the index leaf tissue of coconut. Similar results on increased CIS yield in better managed palms was reported by Muralidharan and Deepthi (2013) [11] who gained that a coconut palm yields on an average 2 liters of neera per day, which may go even up to 4.5 liters per day based on health of the palm and management of the garden. The results are also in line with the findings of Wasantha (2009) [21] who found that sap flow in coconut depends on soil depth, water holding capacity of

soil, and larger leaf area of palm which interns depend on the proper production of coconut palms.

Sap Production Duration

The perusal of results on sap production duration of coconut palms as influenced by levels fertilizer application revealed that there was no significant influence of fertilizer levels on sap production duration. This may be due to the fact that tapping is done on already existing spathe and so the duration of tapping is dependent on inherent palm characters rather than nutrition of the palms. The results are on accordance with the findings of Konan *et al.* (2013) [7] who reported that the duration of sap production of coconut spathe is related to the length of the spathe and regular flow of sap during their exploitation.

pH and Electrolyte Concentration

The pH of CIS was found to be significantly influenced by treatments. The pH of CIS was highest in T₁ (6.70) which was on par with T₃ (6.64) and significantly higher than T₂ (6.40) and T₄ (6.40) which were on par. Naik *et al.* (2013) [12] also reported that neera has pH of 6.8. Similar results were reported by Nakumara *et al.* (2004) [13] and Aalersberg *et al.* (1997) [1] who observed that coconut inflorescence sap has a pH of near neutral. The increasing levels of NPK fertilizers resulted in a decrease in pH of CIS. However the decrease did not show any uniform pattern.

The electrolyte concentration of CIS was observed to be significantly increased with increasing fertilizer levels. It was highest in the treatment receives 75% extra NPK fertilizers (3.96 dSm⁻¹) which was on par with the 50% extra level. Muralidharan and Deepthi (2013) [11] observed that neera has total solids of 15.2-19.7 g/100ml. The increasing levels of fertilizers application would have resulted in increased production of sugars and phenols which would have increased the electrolyte concentration of CIS. The results on sugars and phenols content of CIS obtained in the experiment also are indicative of these results.

Biochemical properties

Reducing sugars, Non-reducing sugars and Total sugars

The content of reducing sugars, non-reducing sugars and total sugars were significantly influenced by treatments. The predominant sugar present in CIS was non-reducing sugars which ranged from 10.27 g/100ml to 9.69 g/100ml. However reducing sugars were in lower concentration (0.42 g/100ml to 0.57 g/100ml). The results are in conformity with that reported by Barh and Mazumdar (2008) [2] who found that fresh CIS has 12 to 15% sucrose and trace amounts of glucose, fructose, maltose and raffinose. Similar results were also obtained by Singavardivel *et al.* (2012) [19] who reported that fresh coconut inflorescence sap contains 12-15% sucrose (non-reducing sugar) content. Konan *et al.*, (2014) [6] observed that soil and the climate conditions can influence the hydric and mineral absorption and during photosynthesis. The increasing sugar content with increasing fertilizer levels can be attributed to the extra nutrients supplied in these treatments which would have resulted in improved sugar parameters such as reducing sugars, non reducing sugars and total sugars. The increased available nutrient status of soil obtained in these treatments is also indicative of these results. Konan *et al.* (2014) [6] also reported that soil conditions and mineral nutrition can influence the production of carbohydrates in palms.

Alcohol

The perusal of results obtained on alcohol content in fresh CIS obtained from different treatments indicates the presence of alcohol in the sap in all the treatments. Increasing levels of fertilizer application has resulted in a significant increase in alcohol content with the highest level of 0.09% in the treatments receiving 75% extra NPK fertilizer over POP recommendation. The sugars present in the fresh CIS would have undergone partial fermentation which would have enhanced the alcohol content of sap. It should be also noted that the highest sugar content (reducing, non-reducing and total sugars) was also associated with the treatment receiving 75% extra NPK fertilizer which may be the reason for the present trend of results obtained with respect to alcohol content. The results are in conformity with those reported by Nur aimi *et al.* (2013) [14] that attributed the presence of alcohol in fresh coconut inflorescence sap to the presence of naturally present yeast in the sap which would have spontaneously started fermentation of sap even while still in the tapping process.

Phenol and Vitamin-C

The results obtained from the present investigation revealed a significant increase in phenol content in coconut inflorescence

sap. Application of 175% POP recommendation were superior in terms of phenol content (2.56 mg/100ml). The higher concentration of primary, secondary and micro nutrients in the palms receiving higher levels of NPK fertilizers would have resulted in greater synthesis of phenols which has reflected in higher phenol content in sap. Similar results on total phenolic content of coconut inflorescence sap was reported by Shymala Devi *et al.* (2015) [20] who observed that fresh CIS has a total phenolic content of 0.34 mg/l. There was a significant influence of nutrition to coconut in terms of higher levels of NPK fertilization on vitamin - C content of coconut inflorescence sap. It increased from 1.74 mg/100ml in the treatments receiving the POP recommendation of fertilizers to 2.19 mg/100ml in the highest fertilizer levels *viz.*, 175% POP recommendation. The status of available nutrients in soil and the content of primary, secondary and micro nutrients were also high in the above treatment. This would have facilitated synthesis of vitamin - C at higher levels in the plant which has reflected in the higher concentration of vitamin - C in the sap. The results are in agreement with the views of Hebbar *et al.* (2015) [3] who reported that the essential elements N, P, K, Mg and micronutrients Zn, Fe and Cu give the biochemical constituents in freshly collected coconut inflorescence sap.

Table 1: Influence of nutrition (Different Levels of NPK Fertilizers) on yield, sap production duration and biochemical properties of coconut inflorescence sap.

Treatments	Yield (l/day)	Sap production duration (days)	pH	Electrolyte Concentration (dS/m ⁻¹)	Reducing sugars (g/100ml)	Non-Reducing sugars (g/100ml)	Total sugars (g/100ml)	Alcohol (%)	Phenol (mg/100ml)	Vit- c (mg/100ml)
T1	1.42	46.0	6.70	1.31	0.42	9.69	10.12	0.05	1.54	1.74
T2	2.32	48.2	6.40	3.37	0.44	10.11	10.56	0.06	2.51	1.89
T3	2.78	47.6	6.64	3.85	0.53	10.29	10.82	0.08	2.05	1.98
T4	3.32	45.4	6.40	3.96	0.57	10.27	10.84	0.09	2.56	2.19
CD (0.05)	0.26	NS	0.22	0.33	0.02	0.10	0.11	0.01	0.19	0.21

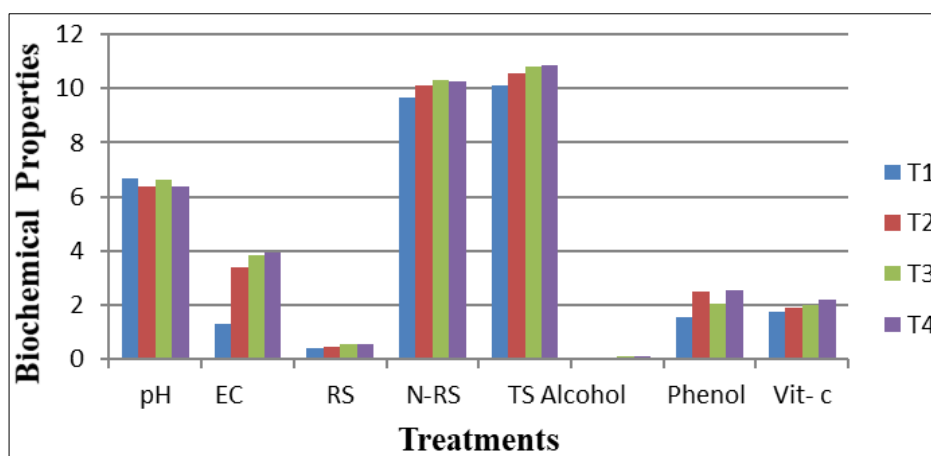


Fig 1: Influence of nutrition (Different Levels of NPK Fertilizers) on biochemical properties of coconut inflorescence sap

Conclusion

Application of 175% POP recommendation was superior to other treatments with respect to CIS yield (3.32 l day⁻¹). There was no significant influence of treatments on sap production duration. There was a significant influence of treatments on biochemical properties and nutritional qualities of CIS. The biochemical properties like reducing sugar (0.57 g 100ml⁻¹), non reducing sugars (10.27 g 100ml⁻¹), total sugars (10.84 g 100ml⁻¹), alcohol (0.09%), phenols (2.56 mg 100ml⁻¹) and vitamin C (2.19 mg 100ml⁻¹) were significantly higher in the treatment receiving 175% POP recommendation.

Acknowledgement

I feel immense pleasure to express my profound and heartfelt thankfulness to my parents, Dr. Biju Joseph (Chairman of the advisory committee) and KAU.

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