



Study on Nutrient Removal (NPK) from Different Parts of Chowghat Orange Dwarf (COD) and West Coast Tall (WCT) Cultivars of Coconut

D. Yuvasri ^{a*}, K. Venkatesan ^{a#}, M. Anand ^b, D. Selvi ^c and L. Pugalendhi ^d

^a Department of Spices and Plantation, HC&RI, TNAU, Coimbatore-03, India.

^b Department of Food Process Engineering, TNAU, Coimbatore-03, India.

^c Department of Soil Science & Agricultural Chemistry, TNAU, Coimbatore-03, India.

^d Department of Vegetable Science, HC&RI, TNAU, Coimbatore-03, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2022/v34i2131285

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/89399>

Original Research Article

Received 29 April 2022

Accepted 13 July 2022

Published 16 July 2022

ABSTRACT

Aims: This research was carried out to study the nutrients removal by different parts of coconut. This palm takes up a lot of nutrients from the ground for growth and development. Removal of nutrients varies from different components of palm. Hence this was carried to study the nutrient removal by different parts of coconut to improve growth.

Study Design: The study was carried out in Factorial Randomized Block Design (FRBD) with 2 factors (A and B) and 4 replications.

Place and Duration of Study: This study was carried out at Coconut Orchard Department of Plantation and Spices Horticultural College & Research Institute Tamil Nādu Agricultural University Coimbatore during 2021-2022.

Methodology: Here the major nutrient (NPK) removal of two varieties Chowghat Orange Dwarf (COD) and West Coast Tall (WCT) were estimated. The nutrient removal was estimated by collecting plant sample before fertilizer application(initial) and 3rd and 6th months after fertilizer application. These samples were dried powdered and analysed with respective procedures and instruments.

Results: The result revealed that the removal of nutrients from parts of coconut is increased from initial (without fertilizer application) to 3rd and 6th months after fertilizer application in both Chowghat

M.Sc. Scholar

*Corresponding author: E-mail: heerayuva@gmail.com;

Orange Dwarf (COD) and West Coast Tall (WCT). There is more removal of potassium compared to nitrogen and phosphorus. The percentage of nutrients removed was 13.52,18.69,21.22 during initial, 3rd month and 6th month in COD as such 16.22,19.8,22.44 in WCT respectively. Comparing with Chowghat Orange Dwarf (COD) and West Coast Tall (WCT) removes more nutrients.

Conclusion: The present study revealed that there was enormous removal of potassium from both varieties Chowghat Orange Dwarf (COD) and West Coast Tall (WCT). So, there is a need to increase in the potassium fertilizer application from normal recommended dose or potassium enriched nutrient application is recommended.

Keywords: Nutrients removal; nitrogen; phosphorus; potassium; Chowghat Orange Dwarf; West Coast Tall.

1. INTRODUCTION

Coconut (*Cocos nucifera* L.) is one of the most important tropical tree crops in the world and is widely known as the “tree of life” for many communities in different nations because it provides a large number of products that can be used to support the local economy [1]. It is placed in palm family (Arecaceae) with chromosome number $2n=32$. Coconut crop as unique versatility because every part of the coconut palm is used, and it produces a range of valuable products, many of which contribute to health maintenance and improvement [1]. There are two important varieties in coconut palm depending on their fruit bearing habit. These are the “tall” and “dwarf” coconut trees. Among these two varieties of coconut the tall variety is slow growing. It starts bearing fruits after 6–10 years of planting, and its productivity is maintained even after 80–120 years. The fruits of the tall variety palm mature in 12 months. Whereas the dwarf variety starts bearing fruit within 1–2 years of planting and gains a height of less than half that of the tall variety [2].

It was reported that there is a regular removal of plant nutrients in coconut palm along with harvested nuts, fallen fronds and other parts of the inflorescences. Many previous studies have shown that all parts of coconut palm like harvested nuts, fronds and other residue removes a considerable quantity of macro and micro nutrients [3]. Studies on nutrient removal will provide a clear understanding of the rate and amount of nutrient depletion from soil. This nutrient depletion of different eco-systems belonging to different productivity categories will be useful in formulating fertilizer recommendations [4]. Information on the rate and amount of nutrient depletion from coconut lands of different yield potentials will be a useful input for developing more logistic approaches to coconut nutrition and soil management [5].

2. MATERIALS AND METHODS

2.1 Location and Crop Variety

The experimental research was carried out in 25 years old coconut plantations having 11° N latitude and 77° E longitude at Coconut Nursery, Department of Spices and Plantation crops, Horticulture College and Research Institute, Tamil Nadu Agricultural University, Coimbatore with elevation of 426 m above mean sea level (MSL). In this study nutrient removal and uptake by coconut was estimated in coconut cultivars COD (Chowghat Orange Dwarf) and WCT (West Coast Tall) planted at a spacing of 7.5m x 7.5m in coconut nursery and their growth characters was also noticed during nutrient removal.

2.2 Physico-chemical Characteristics of Soil

Soil samples were taken from research fields at various depths of 30 cm, 45 cm, 60 cm, and then they are shade dried, powdered and sieved through a 2mm sieve. The available nutrient contents like nitrogen, phosphorus, potassium, pH and EC were analysed in soil samples [6,7] Table 1.

2.3 Nutrient Concentration Analysis of Different Parts of Coconut

To determine the nutrient contents in different parts of coconut samples were collected *viz.*, for leaf nutrient status estimation leaflet samples were collected from either side of rachis of the 14 frond and for frond nutrient status estimation same fronds end part is used. Nuts were also collected and separated in husk and shell. These all samples were dried in hot air oven and made into powdered for estimation of different nutrient contents like nitrogen, phosphorus, potassium and micronutrients. The nutrient contents are estimated by using the following methods.

Sl. No	Properties	Methods	Reference
1.	Available nitrogen (Kg ⁻¹ ha)	Alkaline permanganate method	[8]
2.	Available phosphorus (kg ⁻¹ ha)	Colorimetrically using ammonium molybdate as the colouring agent	[7]
3.	Available potassium (kg ⁻¹ ha)	Flame photometry	[6]
4.	DTPA extractable micronutrients (viz., Fe, Mn, Zn, Cu) (mg ⁻¹ kg)	Atomic Absorption Spectrophotometry (AAS)	[9]

2.4 Observation Recorded

- No of leaves /frond (pairs), No of inflorescences per palm, Trunk height (m), Trunk girth(diameter)(cm), No. of fronds, No. of bunches, no of nuts / bunches, no of nuts/palm, Whole nut weight(kg), Dehusked nut weight (kg), Husk weight(kg), Shell weight (kg), Weight of entire leaf with fronds (green)kg, Weight of entire leaf with fronds(dried)kg, Volume of nut water(ml).

3. RESULTS

The experimental field soil chosen for research contains nitrogen at 213 kg/ha (WCT) and 193 kg/ha (COD) which is found to be low in both the field. The phosphorus at 23.5 kg/ha (COD), 39 kg/ha (WCT) and potassium content of 511 kg/ha (COD), 981 kg/ha (WCT) which is found highest in the field. Both the fields were slightly alkaline with pH range of 8.00-8.30 and EC of 0.20-0.21 ds/m shows it is non saline in nature (Table 1). Soil analysis of these field showed that soil

Table 1. Soil analysis of experimental plot at initial stage

Parameter	Initial soil analysis			
	West coast tall		Chowghat orange dwarf	
	Value unit	Comments	Value unit	Comments
pH	8.05	Slightly alkaline	8.00	Slightly alkaline
EC	0.20 ds/m	Non saline	0.21 ds/m	Non saline
Available N	213 kg/ha	Low	193 kg/ha	Low
Available P	39 kg/ha	High	23.5 kg/ha	High
Available K	981 kg/ha	High	511 kg/ha	High

Table 2. Growth characters of Chowghat Orange Dwarf (COD) and West Coast Tall (WCT)

S. No	Parameters	Chowghat Orange Dwarf	West Coast Tall
1	No of leaves /frond (pairs)	90.25	94.25
2	No of inflorescences per palm	5-6	8-12
3	Trunk height (m)	8.56	15.25
4	Trunk girth(diameter)(cm)	26.77	28.36
5	No. of fronds	16	24.25
6	No. of bunches	3.25	6
7	No of nuts / bunches	5.27	4.15
8	No of nuts / palm	16.5	25
9	Whole nut weight(kg)	0.92	1.12
10	Dehusked nut weight (kg)	0.44	0.56
11	Husk weight(kg)	0.41	0.49
12	Shell weight(kg)	0.16	0.18
13	Weight of entire leaf with fronds (green)kg	3.30	3.45
14	Weight of entire leaf with fronds(dried)kg	1.33	1.51
15	Volume of nut water (ml)	196.1	210

Table 3. Nitrogen removal from different parts of COD and WCT varieties of coconut (%)

N(%) Treatments	Leaf				Fronds				Shell				Husk			
	initial	3 rd month	6 th month	Mean	initial	3 rd month	6 th month	Mean	initial	3 rd month	6 th month	Mean	initial	3 rd month	6 th month	Mean
Nutrient removal in COD	1.95	2.17	2.35	2.16	0.78	1.01	1.06	0.95	0.55	0.34	0.75	0.54	0.87	1.36	1.25	1.16
Nutrient removal in WCT	2.52	2.60	2.76	2.63	1.20	1.28	1.48	1.32	0.92	0.71	0.86	0.83	1.41	1.60	1.75	1.59
MEAN	2.23	2.39	2.56	2.39	0.99	1.15	1.27	1.13	0.73	0.52	0.80	0.69	1.14	1.48	1.50	1.37
	A	B	A*B		A	B	A*B		A	B	A*B		A	B	A*B	
SEd	0.03	0.04	0.05		0.03	0.04	0.06		0.01	0.02	0.02		0.03	0.04	0.05	
CD (0.05)	0.06	0.08	0.11		0.07	0.09	0.12		0.03	0.04	0.05		0.06	0.08	0.11	

Table 4. Phosphorus removal from different parts of COD and WCT varieties of coconut (%)

P(%) Treatments	Leaf				Fronds				Shell				Husk			
	initial	3 rd month	6 th month	Mean	initial	3 rd month	6 th month	Mean	initial	3 rd month	6 th month	Mean	initial	3 rd month	6 th month	Mean
Nutrient removal in COD	0.13	0.18	0.35	0.22	0.26	0.23	0.47	0.32	0.04	0.06	0.12	0.07	0.49	0.40	0.68	0.52
Nutrient removal in WCT	0.55	0.40	0.61	0.52	0.70	0.44	0.68	0.61	0.27	0.15	0.28	0.23	0.83	0.73	0.87	0.81
MEAN	0.34	0.29	0.48	0.37	0.48	0.33	0.58	0.46	0.15	0.10	0.20	0.15	0.66	0.57	0.78	0.67
	A	B	A*B		A	B	A*B		A	B	A*B		A	B	A*B	
SEd	0.01	0.01	0.02		0.01	0.01	0.01		0.01	0.01	0.01		0.01	0.01	0.02	
CD (0.05)	0.02	0.03	0.04		0.02	0.02	0.03		0.01	0.02	0.02		0.02	0.03	0.04	

Table 5. Potassium removal from different parts of COD and WCT varieties of coconut (%)

K (%) Treatments	Leaf				Fronds				shell				Husk			
	initial	3 rd month	6 th month	Mean	initial	3 rd month	6 th month	Mean	initial	3 rd month	6 th month	Mean	initial	3 rd month	6 th month	Mean
Nutrient removal in COD	0.60	0.54	0.83	0.65	1.47	1.55	1.80	1.61	0.51	0.37	0.73	0.53	7.77	7.72	8.29	7.93
Nutrient removal in WCT	0.96	0.81	0.93	0.90	1.93	1.83	1.97	1.91	0.89	0.71	0.85	0.81	8.47	8.22	8.37	8.35
MEAN	0.78	0.67	0.88	0.78	1.70	1.69	1.88	1.76	0.70	0.54	0.79	0.67	8.12	7.97	8.33	8.14
	A	B	A*B		A	B	A*B		A	B	A*B		A	B	A*B	
SEd	0.01	0.02	0.02		0.02	0.02	0.03		0.01	0.01	0.02		0.11	0.13	0.19	
CD (0.05)	0.03	0.04	0.05		0.03	0.04	0.06		0.03	0.03	0.04		0.23	0.29	0.40	

texture is clay loam and sandy clay loam with Calcareous lime status.

3.1 Growth Characters

Many growth parameters like no of leaves /frond (pairs), no. of fronds, no. of bunches no of nuts / bunches and no of nuts / palm as 94.25, 24.25,6, 4.15,25 of West Coast tall variety was highest compared to chowghat orange dwarf has 90.25,16.3.25, 5.27,16.5. Though the bearing stage of tall variety is late compared to dwarf variety the yield parameters are higher in tall varieties (Table 2).

3.2 Nutrient Removal at Different Stage

The removal of N from different parts mean showed that leaf removes a large amount of N in both the varieties (COD -2.16%, WCT- 2.63%) followed by husk. Removal of nitrogen content from plant components was gradually increased from initial (no fertilizer application) to 3rd and 6th month after fertilizer application Table 3.

Removal of phosphorus from different parts is presented in Table 4. The removal of P from different parts mean showed that all parts remove a specific moderate quantity of P at range of 0.20%-0.70%. Husk which removes 0.67% of P. Removal of phosphorus content from plant components also increased gradually from initial (no fertilizer application) to 3rd and 6th month after fertilizer application.

The amount of K removed from different parts of coconut palm is presented in Table 5. Potassium one of the important major nutrients was the highest removed compared to other major nutrients N and P. Husk is a part in coconut which removes enormous amount of K (8.14%). Other all parts remove only small quantity. Potassium removal also slowly increased from initial (without fertilizer application) to 3rd and 6th months after fertilizer application.

4. DISCUSSION

The coconut palm extracts various amounts of macronutrients from different sections of the plant. The nuts removed far more K and N than P. K depletion may occur quickly through exchangeable soil by fallen plant components and harvested nuts in the plantation if K fertilizer is applied at a greater rate alone with other N and P fertilizers [10].

Despite applying the prescribed fertilizer, the depletion rate of exchangeable K in the soil would be 38.3 kg ha⁻¹ yr⁻¹ at a production rate of 7,500 nuts ha⁻¹yr⁻¹. As a result, the depletion should be compensated for either by increasing the amount of chemical fertilizer used or by recycling the palm's organic components [3,5].

Application of extra 80 kg ha⁻¹ of MOP would be sufficient to fill the gap between K removal and input by fertilizer. It is important to note that K input to soil at the recommended rate of both fertilizer and a mulch with all the fallen coconut fronds would be 156.7 kg ha⁻¹ yr⁻¹, which is still less than the rate of through uptake by the palm [11].

If all fallen fronds and inflorescences applied as mulch to the manure circles and incorporated to the soil, the rate of depletion of K would be decreased considerably.

Husk the part of coconut removes higher amount of K. This can be overcome by practicing mulch of fresh husk in the manure circle because the husk contains 35% of water-soluble K. this would help in saving inorganic fertilizers and compensate the effect of depletion [12].

5. CONCLUSION

The results of the current investigation showed that different coconut portions remove varied amounts of the major nutrients, with potassium being the one eliminated most frequently. The most K is removed by both COD and WCT. When comparing total nutrient removal from coconut palm plant parts, West Coast Tall removes more nutrients than Chowghat Orange Dwarf. There is a need to apply more fertiliser than is advised, especially for potassium, due to an increased removal of potassium from the crop.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Laura J. Pham coconut (*Cocos nucifera*).
2. Foale M, Roebeling P. In coconut revival— new possibilities for the 'tree of life.' Proceedings of the International Coconut Forum, Cairns, Australia. Australian Centre

- for International Agricultural Research. 2006;11-47.
3. Somasiri LLW, Wijebandara DMDI, Pandithratne BDP, Sabaratnam S, Kurudukubura CPA and Pathirana KPA. Study on nutrient removal by Tipica x Tipica coconut palms in high potential lands. Proceedings of the Sri Lanka Association for the Advancement of Science. 2001;57(1):40.
 4. Somasiri LLW, Nadaraja N, Amarasinghe L and Gunathilake HAJ. Land suitability assessment of coconut growing areas in the coconut triangle, Coconut Research Institute, Lunuwila, Sri Lanka; 1994.
 5. Somasiri LLW, Wijebandara DMDI, Pandithratne BDP, Sabaratnam S and Kurudukubura CP A. Losses of, ' nutrient in a high yielding coconut Plantation through removal of plant materials from the field. Cocos. 2003;15:12-22.
 6. Jackson M. Soil chemical analysis, advanced course: publ. by the author, Dept." Soil Science, Univ. Wisc., Madison, Wisconsin. 1973;183-204.
 7. Olsen SR. Estimation of available phosphorus in soils by extraction with sodium bicarbonate.US Department of Agriculture. 1954;72-78.
 8. Subbiah B, Asija G. A rapid method for the estimation of nitrogen in soil. Journal of Current Science. 1956; 26(9):259-260.
 9. Lindsay WL, Norvell W. Development of a DTPA soil test for zinc, iron, manganese, and copper. Soil Science Society of America Journal. 1978;42(3):421- 428.
 10. Silva MATD, Mendis BJA, Appuhamy PADG, Geoge GD. Micronutrients in the nutrition of coconut. Ceylon Cocon. 1994; 25:128-138.
 11. Nadheesha, Tennakoon A. Removal of micronutrients from high and moderate yielding coconut plantations in Sri Lanka. Soils and Plant Nutrition Division; 2003.
 12. Somasiri LLW. Fertilizer increases your coconut yield. Coconut Bulletin. 1987;4:15-22.

© 2022 Yuvasri et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

*The peer review history for this paper can be accessed here:
<https://www.sdiarticle5.com/review-history/89399>*