The Pharma Innovation Journal 2023; 12(4): 1537-1542

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(4): 1537-1542

www.thepharmajournal.com
Received: 22-01-2023
Accepted: 24-02-2023

M Ramya
Department of Soil Science, College of Agriculture Kerala Agricultural University, Kerala, India

NK Binitha
Department of Soil Science, College of Agriculture, Kerala Agricultural University, Kerala, India

Corresponding Author:
NK Binitha
Department of Soil Science, College of Agriculture, Kerala Agricultural University, Kerala, India

An investigation on yield and nutritional quality of hybrids of *Ayiramkachi* coconut (*Cocos nucifera* L.) palms

M Ramya and NK Binitha

Abstract
The study aimed to investigate the yield and nutritional quality of nuts collected from nine coconut hybrids of cultivar *Ayiramkachi* that were grown in Kasargode, Kerala. The coconut hybrids involving tall and dwarf genotypes *viz.* West Coast Tall, Laccadive Ordinary, Philippines, Laccadive Micro, Andaman Ordinary and Malayan Yellow Dwarf with *Ayiramkachi*, planted during 1994 were utilised for the study. Soil available nutrients and nutrient content of coconut kernel of the selected hybrids before and after fertilizer application were assessed. The available nitrogen and available phosphorous were deficient in the soil while available potassium was present in sufficient quantity in pre-fertilized soils. There was only a moderate increase in nitrogen and phosphorous which showed deficiencies of these nutrients in the nuts. The nut nutrient content was found to be a reflection of soil available nutrient status which points out the need for adoption of appropriate nutrient management practices for higher yield and nut quality. Promising high yielding and nutritionally rich hybrids of *Ayiramkachi* were identified in the study.

Keywords: Coconut, hybrid, kernel, *Ayiramkachi*, yield, nutrients, soil

Introduction
Coconut is a perennial crop, widely cultivated in tropical and subtropical regions for its nuts from which fresh kernel, copra and oil are utilized for various purposes. It is a diverse crop rich in nutrients that improves human health in different ways. The hybrid, *Ayiramkachi* is a dwarf genotype palm producing small, oblong shaped nuts, with good quality copra. It is an alternate bearer which has been exhibiting high female flower production with low fruit setting (Sankaran *et al*., 2015) [15].

The properties of soil affects the yield and nutritional quality of coconut. The prevalance of laterite soils and sandy texture in Northern Kerala coupled with high soil acidity pose a threat to nutrient availability to crops including coconut which emphasizes the need for improved nutrient management practices that could increase nutrient use efficiency and yield of palms. Soil available nitrogen content of 80 mg/kg and soil available phosphorous content of 20 mg/kg is considered as sufficient for the optimum nutrition of coconut palms grown in soils of Northern Kerala (Reddy *et al*., 2002) [14]. Available phosphorous is present in large quantity in soil due to overuse of phosphatic fertilizers which could seriously affect the uptake of other nutrients by plants (Loganathan and Balakrishnamurti., 1979) [5]. According to Ramanadan and Pillai (1994) [13] available phosphorus content was higher in soils without manuring than in soils with regular manuring. Potassium deficiency was comparatively higher in Northern foothills, which could be recovered by means of split application of potassic fertilizers (Somasiri, 1997) [17]. According to Malhothra *et al.* (2017) [6], potassium was reported as a major limiting nutrient for coconuts grown in North Kerala which was due to low concentration of this nutrient in acidic soils. Previous study opined that NPK fertilization increased the available zinc, iron, manganese and copper in the soil (Khan *et al*., 1993) [2].

According to Mohandas (2012) [8], coconut growing soils fertilized with 1000:250:2000 g of NPK /palm/year along with organic manure produced higher annual nut yield along with restoration of soil fertility. Soil nitrogen and potassium reported significantly positive correlated with palm yield whereas phosphorus showed a non-significant positive correlation with yield (Thuvasan *et al*., 2019) [21]. Khan (1993) [2] reported that a higher proportion of absorbed nitrogen (62%) and phosphorous (75%) were utilized by the coconut hybrids for producing a greater number of nuts.

Coconut kernel possess considerable amount of minerals in it, which proves it is inevitable to include in human diet. These mineral elements play an important role in several structural and functional activities as electrolytes in order to support human metabolic processes (Yong *et al*., 2009) [22]. According to Prasad (1985) [10], dietary consumption of coconut could inhibit growth retardation, secondary anaemia and infertility. Hence, it is crucial to find out high yielding hybrids that are nutritionally rich. The present study aims to assess the mean performance of Ayiramkachi coconut hybrids for yield and nutritional quality.

Materials and Methods

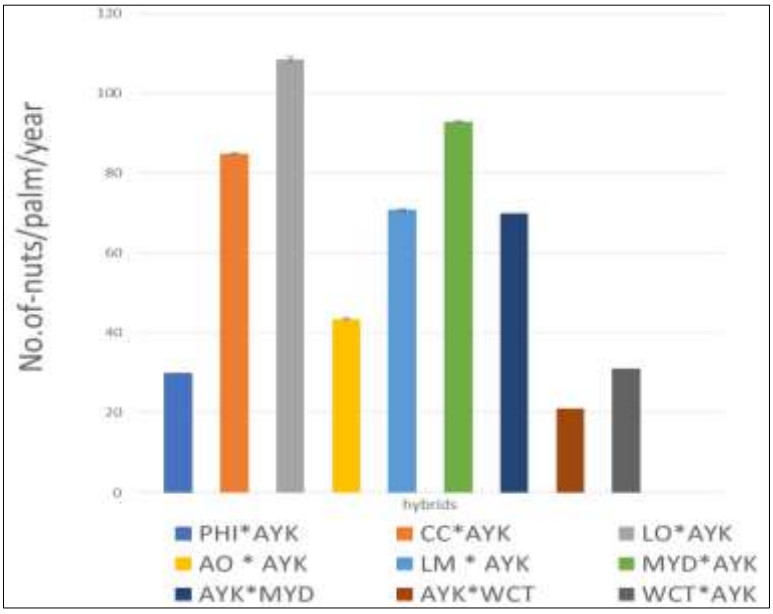
The present study was conducted at College of Agriculture, Padannakkad and Regional Agricultural Research Station, Pilicode during 2019 to 2021. Twenty three palms which are hybrid combinations of *Ayiramkachi* with several tall and dwarf varieties planted at Regional Agricultural Research Station, Pilicode were used for the study. The hybrid combinations and number of palms selected included Philippines* *Ayiramkachi* (PHI*AYK)- five palms, Cochin China* *Ayiramkachi* (CC*AYK)-four palms, Laccadive Ordinary* *Ayiramkachi* (LO*AYK)-two palms, West Coast Tall* *Ayiramkachi* (WCT*AYK)- one palm, Andaman Ordinary* *Ayiramkachi* (AO*AYK)-four palms, Laccadive Micro* *Ayiramkachi* (LM*AYK)- two palms, *Ayiramkachi** West Coast Tall (AYK x WCT)-one palm, Malayan Yellow Dwarf* *Ayiramkachi* (MYD*AYK)-three palms and *Ayiramkachi* * Malayan Yellow Dwarf (AYK*MYD)-one palm. These palms were evaluated for yield characteristics by recording the number of bunches per palm per year, number of nuts per bunch, number of nuts per palm per year. Five mature nuts each from well-established palms were collected during the months of December, February and April and used for analysis of nitrogen, phosphorus and potassium. Kernel was separated out from the nuts, processed and subjected to primary nutrient analysis. Total nitrogen content was determined by modified Kjeldhal digestion method as described by Jackson (1958) [1], phosphorus content by vanadomolybdate yellow colour method given by Piper (1966) [9], potassium content by flame photometry as described by Jackson (1958) [1].

Soil samples for the study was collected 60cm away from the base of the palm, before fertilizer application and two months after application of fertilizers (1:0.5:2 of N:P:K) at a depth of 15 cm, using standard sampling procedures. The field was fertilized with 0.5 kg nitrogen (urea), 0.3 kg phosphorus (rajphos) and 1.0 kg potassium (Mureate of Potash) along with 15 kg organic manures and *Glyricidia* as green leaf manures per palm. The collected samples were processed and used for analysis of available nitrogen, phosphorus and potassium. Available nitrogen in the soil was determined by alkaline permanganate method as described by Subbaiah and Asija (1956) [18], available phosphorus by Bray extraction followed by photoelectric colorimetry (Jackson 1958) [1] and available potassium by flame photometry as per the procedure of Pratt (1965) [11].

Results and Discussion

Yield of palms

Significant difference in number of nuts per palm per year was observed among all the hybrids. Results (Fig 1) showed that LO*AYK is the highest yielding hybrid producing 108 nuts per palm per year and was on par with MYD*AYK with an annual production of 92.3 nuts per palm. Lowest yield of 21 nuts per palm per year was recorded for AYK*WCT followed by PHI*AYK which yielded 29.6 nuts per palm annually. Suchithra and Paramaguru (2019) [19] reported that higher rate of female flower production in hybrids involving tall genotypic palms as female parent was attributed to the production of higher number of bunches as well as higher number of nuts produced per bunch annually. These findings support the results obtained in the present study, as it is evident that hybrids from Tall*Ayiramkachi* cross *viz*. LM * AYK and LO*AYK produced maximum number of nuts per palm per annum.

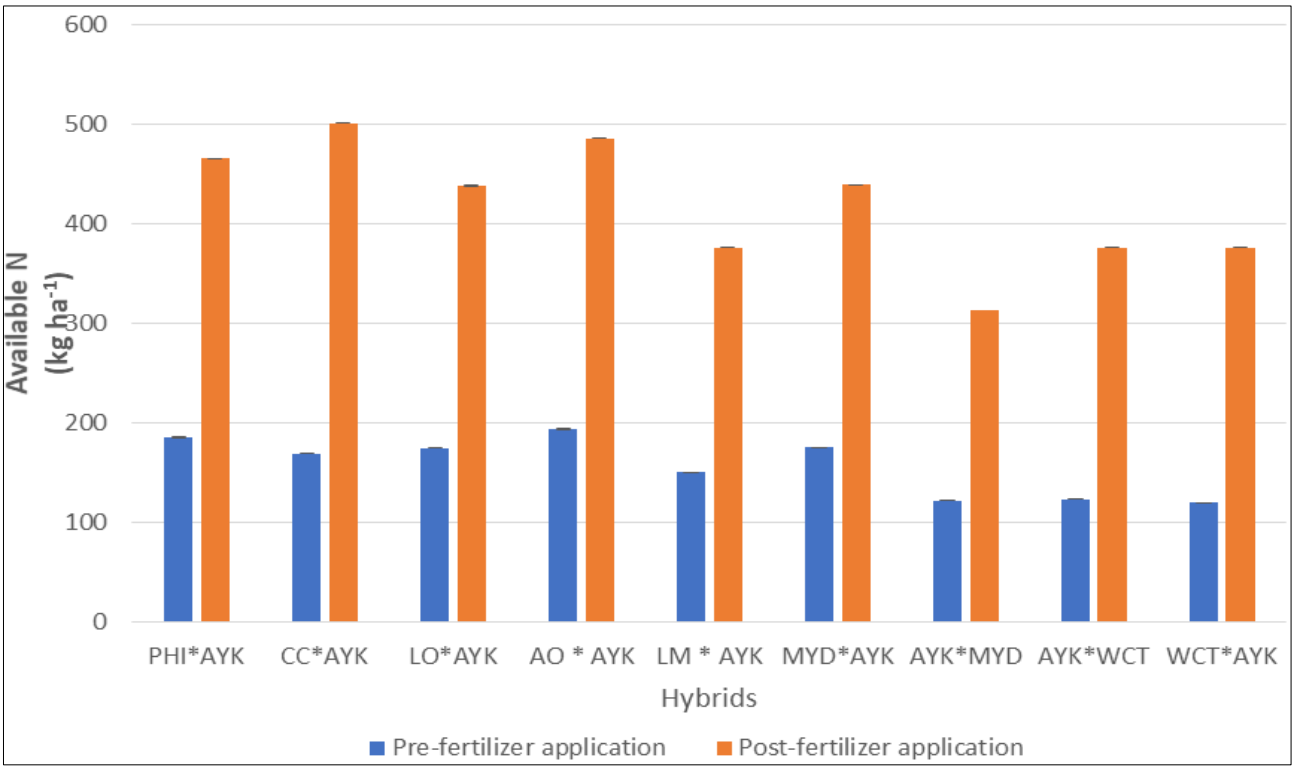


AYK-Ayiramkachi	PHI-Philippines	LO-Laccadive ordinary	CC-Cochin China
AO-Andaman ordinary	LM-Laccadive micro	MYD-Malayan yellow dwarf	WCT-West Coast Tall

Fig 1: Yield of *Ayiramkachi* hybrids

3.2. Available nutrients in soil

Before fertilizer application, available nitrogen in the field was found to be low (Fig. 2). Highest available nitrogen of 194.4 kg ha^{-1} was recorded in soil under AO * AYK, whereas the content was minimum in soil under WCT*AYK with a value of 120.3 kg ha^{-1}. Highest value of 501.8 kg ha^{-1} of available nitrogen was recorded in soil under hybrid CC*AYK during the post fertilization period. The lowest content of available nitrogen was observed in soil under AYK*MYD with a value of 313.6 kg ha^{-1}. Decreased rate of mineralization and decomposition of organic matter in extremely acidic soil conditions might be the reason for low soil nitrogen status recorded in pre-fertilization period. Applied nitrogenous fertilizer (urea), and manure (neem cake and cow dung manure) might have increased the available nitrogen content in the soil during succeeding months.

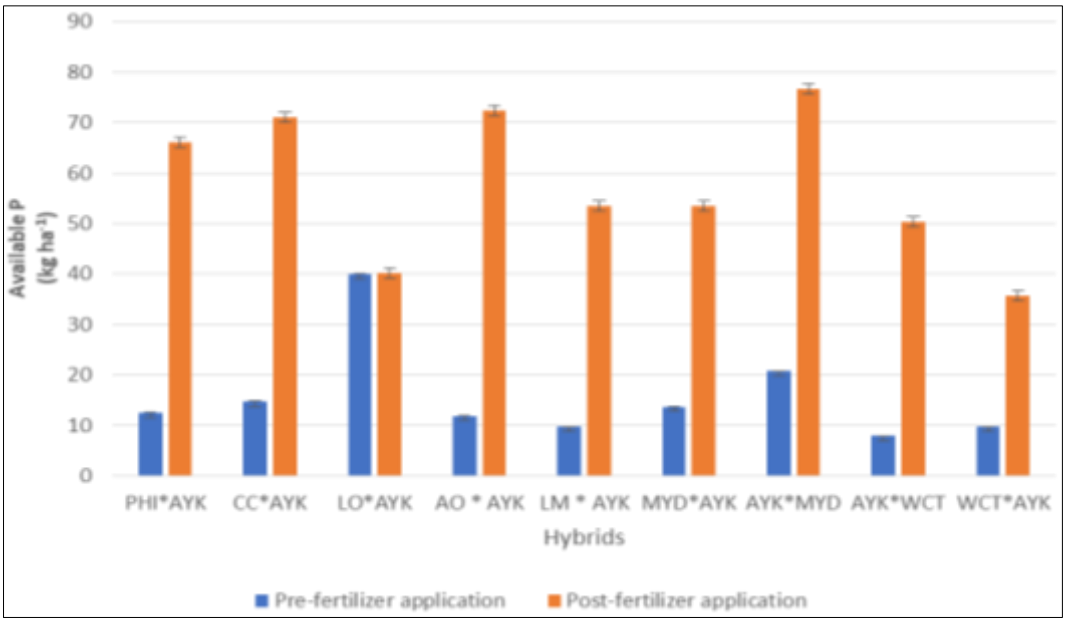


AYK-Ayiramkachi	PHI-Philippines	LO-Laccadive ordinary	CC-Cochin China
AO-Andaman ordinary	LM-Laccadive micro	MYD-Malayan yellow dwarf	WCT-West Coast Tall

Fig 2: Available nitrogen of soils under *Ayiramkachi* hybrids

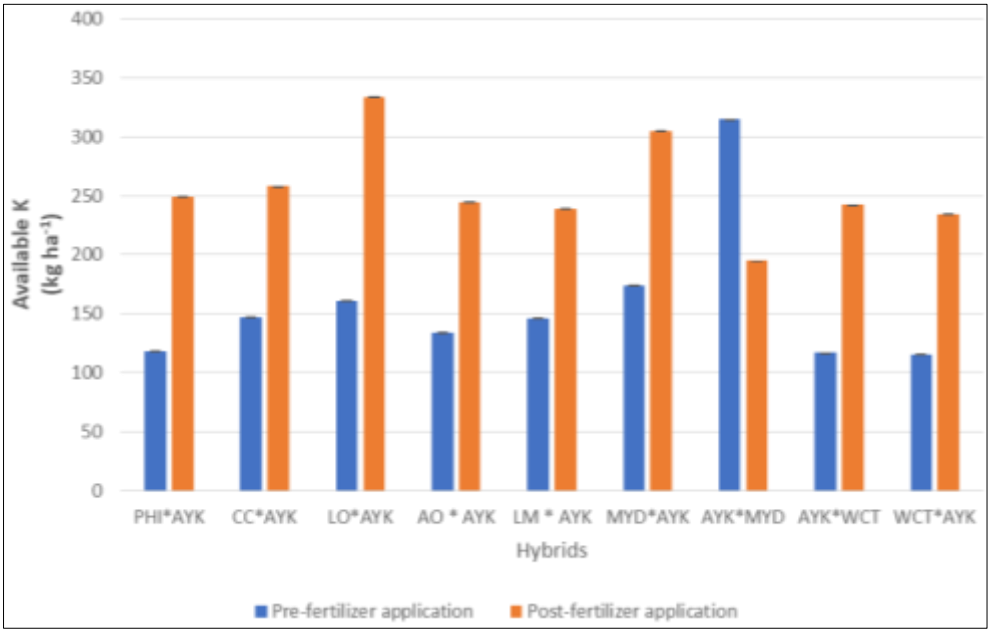
The hybrid LO*AYK recorded the highest soil available phosphorous of 39.9 kg ha^{-1} prior to fertilizer application (Fig. 3) whereas a minimum value of 7.9 kg ha^{-1} of available phosphorous content was observed in soil under hybrid AYK*WCT. After fertilizer application, hybrids AYK*MYD and AO*AYK recorded highest available phosphorous content of 76.6 kg ha^{-1} and 72.5 kg ha^{-1} respectively. The lowest available phosphorous content of 35.6 kg ha^{-1} was recorded in soil under hybrid WCT*AYK. Loganathan *et al.* (1979) [5] reported that coconut growing soils of Srilanka was deficient in phosphorous due to highly acidic nature of soils in which complexes of aluminium are formed which finally results in phosphorous deficiency. Besides, repeated use of nitrogenous fertilizers results in higher accumulation of phosphorous in clay fraction of soil belonging to the order Ultisol, which further undergoes dissolution in acidic soils and finally moves to lower depths of soil profile (Pushparaj *et al.*, 1977) [12]. The applied rajphos and bone meal fertilizer might have increased the available phosphorous content in soil during post-fertilization period.

Available potassium status of the soil under study was found to be medium to high before fertilizer application (Fig. 4). Coconut is a huge feeder of the potassium and hence requires sufficient supply of the nutrient for the formation of fats, fibrous materials and sugars along with the regulation of water levels (Malhotra *et al.*, 2017) [6]. Before fertilizer application, highest potassium content of 314.8 kg ha^{-1} was observed in soil under AYK*MYD followed by MYD*AYK with a value of 174.2 kg ha^{-1}. It was minimum recorded in soil under WCT*AYK with 115.6 kg ha^{-1}of potassium. Available potassium content during post fertilizer application was maximum in soil under LO*AYK with a value of 334 kg ha^{-1} and was followed by MYD*AYK (305.3 kg ha^{-1}) and minimum content of 194.8 kg ha^{-1} potassium was recorded for AYK*MYD. Green leaf manuring with *Glyricidia sepium*, which is rich in potassium might have been contributed to adequate potassium content in soil as a result of decomposition process. According to Loganathan and Balakrishnamurti (1979) [5], coconut palms grown in lateritic soils responded well to muriate of potash fertilizer.



AYK-Ayiramkachi	PHI-Philippines	LO-Laccadive ordinary	CC-Cochin China
AO-Andaman ordinary	LM-Laccadive micro	MYD-Malayan yellow dwarf	WCT-West Coast Tall

Fig 3: Available phosphorus of soils under *Ayiramkachi* hybrids

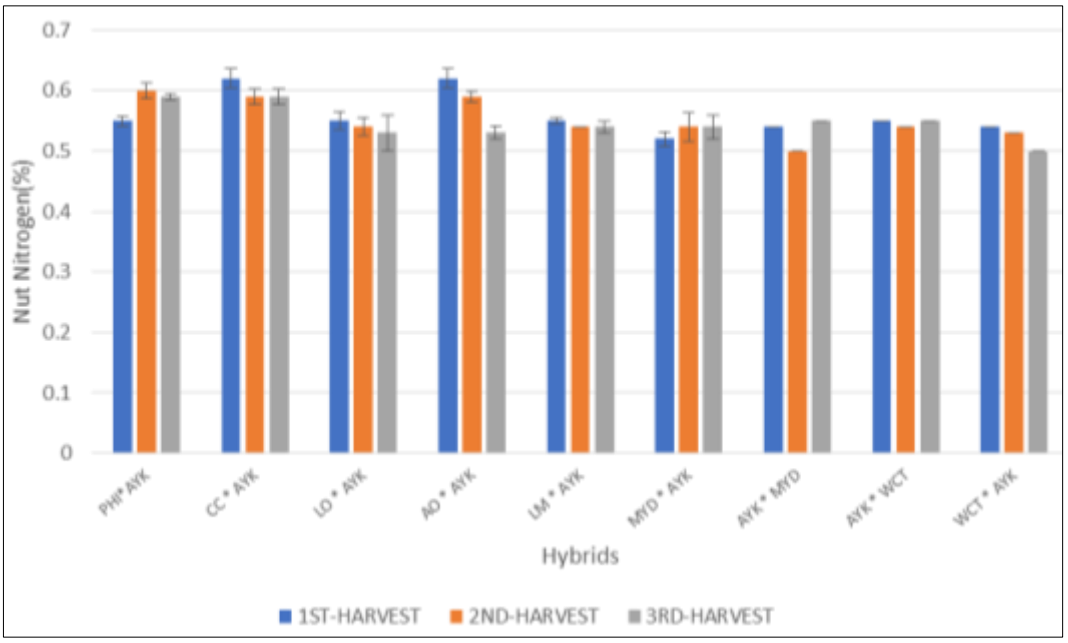


AYK-Ayiramkachi		PHI-Philippines	LO-Laccadive ordinary	CC-Cochin China
AO-Andaman ordinary	LM-Laccadive micro	MYD-Malayan yellow dwarf	WCT-West Coast Tall	

Fig 4: Available potassium of soils under *Ayiramkachi* hybrids

3.3. Nutrient content in kernel

Nitrogen content in kernel varied significantly among the hybrids (Fig. 5). In the first harvest, the highest amount of nitrogen was recorded for AO*AYK (0.623%) and CC*AYK (0.62%). All other hybrids recorded on par values for nitrogen content and the values ranged from 0.52% to 0.55%. In the second harvest, hybrid PHI*AYK recorded the highest value of 0.6% nitrogen and the lowest value of 0.5% nitrogen content was recorded for AYK*MYD which was inferior to all other hybrids. Hybrids PHI*AYK and CC*AYK were recorded with highest nitrogen content of 0.59% each in the third harvest and were on par with hybrids AYK*MYD and AYK*WCT with nitrogen content of 0.55%. Climate, soil, and plant factors viz. age of the palm, extent of root system etc. mainly affected the macronutrient concentration in coconuts (Koyuncu *et al*., 2014) [4]. Deficiency of soil available nitrogen has reflected in the plant nutrient content also. Nitrogen deficiency in nuts might also be attributed to high sulphur content in the nuts as high sulphur reduces nitrogen levels. High yielding hybrids were reported to contain higher nitrogen content in kernel when compared to low yielding hybrids. Nitrogen content gradually increased in nuts from first harvest (in the month of December) to third harvest (in the month of April).



AYK-Ayiramkachi		PHI-Philippines	LO-Laccadive ordinary	CC-Cochin China
AO-Andaman ordinary	LM-Laccadive micro	MYD-Malayan yellow dwarf	WCT-West Coast Tall	

Fig 5: Nitrogen content of kernel of *Ayiramkachi* hybrids

In the first harvest, hybrids AYK*MYD and MYD*AYK were highest in phosphorous content with a value of 0.27% and 0.26% respectively (Fig. 6). Minimum value was recorded in hybrid WCT*AYK with 0.15% of phosphorus content. In the second harvest, hybrid PHI*AYK recorded the maximum phosphorous content of 0.28% which was statistically on par with AO*AYK (0.27%) while the least phosphorous content of 0.19% was recorded for hybrids AYK*WCT and WCT*AYK. Highest amount of phosphorous in nuts from third harvest was recorded for hybrids LO*AYK (0.29%) and AO*AYK (0.27%). Phosphorus imparts better root growth and higher yield in coconuts and it was in line with the results of the present study. All the hybrids produced higher number of bunches per palm in our study. Though the available phosphorus analysed at pre-fertilizer application was low in the soil, it was present in sufficient amount in the nuts. The low availability of phosphorus in the soil caused a preferential movement of the nutrient to the fruit, causing its reduction in leaf (Thomas, 1973) [20]. It is interesting to note that phosphorus uptake by coconut was found to be only one tenth of potassium uptake (Khan et al., 1985) [3]. Significant variation was observed for phosphorus content in kernel among the hybrids.

Nut potassium content varied significantly among the hybrids (Fig. 7). During the first harvest, highest value of potassium was recorded for CC *AYK (1.25%) followed by AO*AYK (0.71%) and the lowest value was recorded in AYK*WCT (0.23%) and WCT*AYK (0.22%). Maximum value of 1.07% and 0.9% potassium in nuts from the second harvest were respectively recorded for hybrids CC*AYK and AO*AYK. Among the hybrids, AYK*WCT and WCT*AYK were inferior for potassium content with a value of 0.23% and 0.22% respectively. In the third harvest, highest potassium content was recorded by hybrid AYK*MYD with 0.9% potassium which was on par with CC*AYK and LM*AYK, each with 0.82% potassium. Lowest potassium content was reported in hybrid AYK*WCT (0.6%). Huge quantity of potassium was present in the mature meat of Malayan yellow dwarf coconut cultivar (Solangi and Iqbal, 2011) [16]. This character of MYD might have transmitted to its hybrid with high potassium content in nut. Higher potassium status in the soil has not reflected much in the nutrient content in nuts. According to Mickelson et al. (2003) [7], high soil available nutrient increased its content in kernel up to a certain level.

Conclusion

It can be concluded from the findings of the study, that the nut nutrient content was reflected by soil available nutrient status. Initially, available nitrogen, available phosphorous, were deficient in the soil while potassium was present in sufficient quantity. Also, only a moderate increase in nitrogen and phosphorous were observed, that resulted in deficiencies of these nutrients in the nuts. Available potassium level was satisfactory in the soil after fertilizer application. From the study, it was found that proper nutrient management practices need to be carried out in the field for increasing yield of hybrid palms and quality of nuts. With respect to yield, hybrid LO*AYK produced the maximum number of 108 nuts per palm per year. It was followed by MYDxAYK, which can be treated as a high yielding hybrid. Ayiramkachi hybrid nuts were found to be a rich source of nutrients like phosphorus and potassium. Nuts of hybrids AO*AYK, CC*AYK and PHI*AYK are rich in nitrogen, phosphorus and potassium. The results shows that promising high yielding hybrids could be identified for coconut-based industries that are nutritionally rich, in order to develop novel products of coconut.

References

1. Jackson ML. Soil chemical analysis. In Cliffs, E. N. J. (ed.). Soil Science University of Wisconsin, USA, Madison; c1958. p. 89-102.
2. Khan HH. Fertilizer management in coconut. In: Fertilizer Management in Commercial Crops., New

Delhi; c1993. p. 150-154.
3. Khan HH, Biddappa CC, Joshi OP. A review of Indian work on phosphorus nutrition of coconut. J Plant. Crops. 1985;13(1):11-21.
4. Koyuncu F, Çetinbaş M, Ibrahim E. Nutritional constituents of wild-grown black mulberry (*Morus nigra* L.). J Appl. Bot. Food Qual. 2014;87:93-96.
5. Loganathan P, Balakrishnamurti TS. Effect of NPK fertilizers on the yield and leaf nutrient concentrations of adult coconut on a lateritic gravelly soil in Sri Lanka. Ceylon Coconut Quarterly. 1979;30:81-90.
6. Malhotra SK, Maheswarappa HP, Selvamani V, Chowdappa P. Diagnosis and management of soil fertility constraints in coconut (*Cocos nucifera*): A review. Indian J Agric. Sci. 2017;87(6):711–726.
7. Mickelson S, See D, Meyer FD, Garner JP, Foster CR, Blake TK, *et al*., Mapping of QTL associated with nitrogen storage and remobilization in barley (*Hordeum vulgare* L.) leaves. J Exp. Bot. 2003;54(383):801-812.
8. Mohandas S. Effect of NPK fertilizer levels on mineral nutrition and yield of hybrid (tall× dwarf) coconut. Madras Agric. J. 2012;99(1):87-91.
9. Piper. Aging of crystalline precipitates. Analyst. 1966;77:1000-1001.
10. Prasad AS. Clinical manifestations of zinc deficiency. Ann. Rev. Nutr. 1985;5:341-363.
11. Pratt PF. Potassium in methods of soil analysis. (2nd Ed.). American Society of Agronomy, Madison, USA. 1965. p. 1019-1021.
12. Pushparajah E, Wahab MA, Lau CH. Residual effect of applied pH Hevea and Pueraria. J Rubber Res. Inst. Malays. 1977;25(3):101-108.
13. Ramanandan PL, Pillai NG. Effect of continuous cultivation and manuring on the leaf nutrient composition and soil nutrient status of coconut palms. J Plant. Crops. 1994;2(2):1-3.
14. Reddy SDV, Upadhyay AK, Gopalasundaram P, Hameed Khan H. Response of high yielding coconut variety and hybrids to fertilization under rainfed and irrigated conditions. Nutrient Cycling Agroecosystems. 2002;62(2):131-138.
15. Sankaran M, Damodaran V, Jerard BA, Abirami K, Roy DS. Multiple Spicata Coconut (MSC): A Rare Type of Coconut in Andaman Islands Transcriptomics. Philipp. J Coconut Stud. 2015;5:23-30.
16. Solangi AH, Iqbal MZ. Chemical composition of meat (kernel) and nut water of major coconut (*Cocos nucifera* L.) cultivars at coastal area of Pakistan. Pakist. J Bot. 2011;43(1):357-363.
17. Somasiri LLW. The interaction between potassium and magnesium red yellow podzolic soils with laterite and its effect on nutrition of coconut palms. J Coconut Res. Inst. Sri Lanka. 1997;12:18-32.
18. Subbiah BV, Asija GLA. A rapid procedure for the estimation of available nitrogen in soil. Curr. Sci. 1956;32:325-327.
19. Suchithra M, Paramaguru P. Studies on performance of certain indigenous and exotic coconut genotypes [*Cocos nucifera* L.]. Electr. J Plant Breed. 2019;10(2):899-921.
20. Thomas KM. Nutrient composition of coconut leaves and its relationship to nut yields in Tanzania. E. Afr. Agric. For. J. 1973;39(2):170-175.
21. Thuvasan KT, Selvi D, Kannan B. Impact of soil available nutrients on yield of coconut under Dindigul and Erode districts of Tamil Nadu. J Pharmacognosy Phytochemistry. 2019;8(6):304-305.
22. Yong JW, Ge L, Ng YF, Tan SN. The chemical composition and biological properties of coconut (*Cocos nucifera* L.) water. Molecules. 2009;14(12):5144-5164.