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Effect of Hybrid Coconut Cultivation on properties of Littoral Sandy Soil of Odisha

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ABSTRACT: An experiment was conducted at Coconut Research Station in Konark, Odisha to assess the impact of hybrid coconut cultivation on the properties of littoral sandy soil of Odisha. The study was conducted during July 2020 to June 2022, following Randomized Block Design with 14 coconut germplasms including hybrids and tall high yielding varieties. Each treatment represents one sample and for each treatment soil samples were collected from two random palms from different depths in each replication. Results showed that pH of soil at 0-50cm ranged from 5.69-5.9 and 5.64-5.93 and from 5.61-5.84 and 5.72-6.06 at 50-100cm soil depth in the beginning and end of the study, respectively. The initial EC values at the 0-50cm depth were highest in soil collected from LCOT × COD, COD × WCT, LCOT, LCOT × GBGD and WCT × GBGD, while at the end of the experiment, the maximum EC was observed in soil collected from GBGD × ECT, LCOT and LCOT × GBGD i.e., 0.007 ds/m. At 50-100cm zone of soil the maximum EC in the beginning was observed in the soil collected from LCOT × COD, COD × WCT, LCOT × GBGD & WCT × GBGD, while the maximum EC at the end of experiment was observed in the soil collected from GBGD × PHOT, COD × WCT, MYD × ECT and WCT × GBGD i.e., 0.008 dS/m. Initial OC at 0-50cm depth ranged from 2.42 to 2.81 g/Kg and from 2.45 to 2.92 g/Kg at the end, while at the 50-100cm depth, soil collected from ECT × GBGD (1.93 g/Kg and 1.96 g/Kg) had the highest OC initially and also at the end. Available nitrogen, phosphorus, and potassium showed no significant differences in the 0-50cm and 50-100cm depth. Overall, hybrid coconut cultivation had minimal effects on soil properties, except for electrical conductivity, which varied significantly due to salt accumulation and poor water retention capacity of the littoral sandy soil.

Keywords: Littoral sandy soil, hybrid coconuts, nutrient availability, electrical conductivity.

INTRODUCTION

Coconut (*Cocos nucifera*) is one of the most important economic crops cultivated in coastal regions worldwide. The development and utilization of hybrid coconut varieties have gained significant attention due to their improved productivity and resistance to pests and diseases. Among all the coconut growing belts, there is significant area under coconut in littoral sand of sea coast in India. Odisha is an important state with regard to the cultivation of this crop occupying 5th position in area and 7th position in production. Coconut is cultivated in an area of 51.71 thousand hectares with an annual production of 354.57 million nuts but the productivity of the coconut per hectare in Odisha is comparatively low i.e., 6857 nuts/ha compared to the national productivity of 9345 nuts/ha (CDB, 2019-20). One of the reasons for such low productivity might be due to cultivation of this crop in poor soils of coastal littoral sand of 410 km long coast line. The general weather prevailing along the coastal belt is fabulous for growing coconut. But, the productivity status of such plantation is very low in the littoral sand ranging from 20-40 nuts/palm/year (Subramanian *et al.*, 2009). The reasons for low productivity of coconut under littoral sand are low organic carbon content, high bulk density, poor aggregate stability, poor water holding capacity, high soil temperature and poor soil fertility status (Reddy and Upadhyay 2002). Even regular application of chemical fertilizers failed in building up of soil nutrient status in littoral sandy soil which is mainly due to low nutrient retention capacity of the soil (Reddy *et al.*, 1999). The very low clay content leading to high infiltration and percolation rate coupled with low cation exchange capacity and low organic carbon content are subject to high leaching loses of applied nutrients during monsoon and severe moisture stress during summer. Also, the problem of poor productivity is aggravated by the loss of organic matter of soil due to hot and humid climate (Sahoo and Maheswarappa 2020). The coconut palms are generally planted at a wider spacing of 7.5m × 7.5m or more due to morphological features such as crown shape and length of leaves. However, the effective root zone of the adult bearing palm is confined laterally within a radius of 2m around the base of the palm (Kushwah *et al.,* 1973; Anilkumar and Wahid 1989). Over 95% of the roots are found in the top 0-120 cm depth out of which 18.9 % and 63 % roots are confined to top 0-30cm and 31-90 cm depth respectively (Maheswarappa *et al.,* 2000). Hence, from the land utilization point of view, the sole crop of coconut with a spacing of 7.5m × 7.5m effectively uses only 22.3 percent of land area by leaving considerable inter and intra row space for proper utilization by intercrops. Even though coconut is a widely spaced crop, the interspaces cannot be utilized for growing of intercrops in littoral sand under normal conditions due to poor water retention capacity and poor soil fertility status. However, by adopting proper soil and water conservation measures selective intercrops can be raised in the coconut garden in littoral sand. This research aims to investigate the changes in soil properties when grown with hybrid coconut in littoral sand environments and the findings will provide valuable insights into the sustainability and management of coconut cultivation in coastal areas.

MATERIALS AND METHODS

This experiment was conducted in the experimental site of All India Coordinated Research Project on Palms (OUAT), Konark, Puri operating under the department of Fruit Science and Horticulture Technology, College of Agriculture, OUAT, Bhubaneswar during July 2020 to June 2022 with 14 coconut germplasms including hybrids and tall high yielding varieties at a spacing of 7.5m × 7.5m and following Randomized Block Design. The research station is four kilometers away from the great 'Sun Temple' of Odisha and is in close proximity to the shore of Bay of Bengal. The experimental station is situated at 19°53′27″N latitude and 86°06′01″E longitude with an altitude of 2m above mean sea level.

A. Soil sample collection techniques

Soil samples were collected at 1.25m away from the bole using a screw augur from four opposite locations around the bole from two depths viz. 0-50 cm and 50-100 cm. Each treatment represents one sample and for each treatment soil samples were collected from two random palms from different depths in each replication. The samples were air dried under shade after through mixing and sieved to pass through 2mm size before analysis. The pH of littoral sand was determined in 1:2.5 soil: water suspension by glass electrode using digital pH meter (Piper, 1966). The organic carbon content was estimated by Walkley and Black wet oxidation method as described by Jackson (1973) and was expressed in g/kg. The determination of electrical conductivity (EC) is made with a conductivity cell by measuring the electrical resistance of a 1:5 soil: water suspension. The available nitrogen content in the soil was determined by alkaline permanganate method (Subbiah and Asija 1956) and was expressed in kg/ha. The available phosphorous content in the soil was estimated by Bray's extractant spectrophotometry method (Jackson, 1973) and was expressed in kg/ha.The available potassium content in the soil was determined by flame photometer method (Jackson, 1973).

RESULTS AND DISCUSSION

The pH of soil at 0-50cm and 50-100cm zone of the soil at the beginning as well as at the end of the experiment is presented in Table 1. At 0-50cm zone of soil no significant difference was observed in soil pH at the beginning as well as at the end of the experiment. However, the pH ranged from 5.69-5.9 and 5.64-5.93 in the beginning and end of the study, respectively. Similarly, at 50-100cm zone of soil no significant difference was observed in soil pH at the beginning as well as at the end of the experiment. However, the pH ranged from 5.61-5.84 and 5.72-6.06 in the beginning and end of the study, respectively. The electrical conductivity (EC) of soil at 0-50cm and 50-100cm zone of the soil at the beginning as well as at the end of the experiment is presented in Table 2. At 0-50cm zone of soil significant variation was observed in the starting as well as at the end of the experiment for EC of the soil. The maximum EC was observed in the soil collected from LCOT × COD, COD × WCT, LCOT, LCOT × GBGD and WCT × GBGD i.e., 0.007 ds/m which was significantly higher than that of other observations and at the end of the experiment and the maximum EC was observed in the soil collected from GBGD × ECT, LCOT and LCOT × GBGD i.e., 0.007 dS/m which was significantly higher than that of other observations. At 50-100cm zone of soil significant variation was observed in the beginning as well as at the end of the experiment for EC of the soil. The maximum EC in the beginning was observed in the soil collected from LCOT × COD, COD × WCT, LCOT × GBGD & WCT × GBGD i.e., 0.008 dS/m which was significantly higher than other observations and the maximum EC at the end of experiment was observed in the soil collected from GBGD × PHOT, COD × WCT, MYD × ECT and WCT × GBGD i.e., 0.008 dS/m which was significantly higher than all the other observations. The organic carbon (OC) of soil at 0-50cm and 50-100cm zone of the soil at the beginning as well as at the end of the experiment is presented in Table 3. At 0-50cm zone of soil no significant difference was observed in OC content of the soil at the starting as well as end of the experiment. However, the OC ranged from 2.42-2.81 g/Kg and 2.45-2.92 g/Kg in the beginning and end of the study, respectively. At 50-100cm zone of soil significant variation was observed in the beginning as well as at the end of the experiment for OC of the soil. The higher organic carbon content was observed in the soil collected from ECT × GBGD (1.93 g/Kg) which was found statistically on par with COD × WCT (1.87 g/Kg) and was significantly higher than other observations and in the end of the experiment maximum OC was observed in the soil collected from ECT × GBGD (1.96 g/Kg) which was statistically on par with COD × WCT (1.94 g/Kg) & GBGD × ECT (1.89 g/Kg) and was significantly higher than other observations.The available nitrogen of soil at 0-50cm and 50-100cm zone of the soil at the beginning as well as at the end of the experiment is presented in Table 4. At 0-50cm zone of soil, significant difference was observed in available nitrogen of soil at the beginning as well as at the end of the experiment. However, the available nitrogen of soil ranged from 113.04-113.47Kg/ha and 113.90-114.34 Kg/ha in the beginning and end of the study, respectively. Similarly, at 50-100cm zone of soil no significant difference was observed in available nitrogen of soil at the beginning as well as at the end of the experiment. However, the available nitrogen of soil ranged from 81.73-82.06 Kg/ha and 84.22-84.65 Kg/ha in the beginning and end of the study, respectively. The available phosphorus of soil at 0-50cm and 50-100cm zone of the soil at the beginning as well as at the end of the experiment is presented in Table 5. At 0-50cm zone of soil no significant difference was observed in available phosphorus of soil at the beginning as well as at the end of the experiment. However, the available phosphorus of soil ranged from 16.16-16.83Kg/ha and 16.69-17.31 Kg/ha in the beginning and end of the study, respectively. Similarly, in 50-100cm zone of soil no significant difference was observed in available phosphorus of soil at the beginning as well as at the end of the experiment. However, the available phosphorus of soil ranged from 12.62-13.17 Kg/ha and 13.13-13.86 Kg/ha in the beginning and end of the study, respectively. The available potassium of soil at 0-50cm and 50-100cm zone of the soil at the beginning as well as at the end of the experiment is presented in Table 6. At 0-50cm zone of soil no significant difference was observed in available potassium of soil at the beginning as well as at the end of the experiment. However, the available potassium of soil ranged from 114.15-115.44Kg/ha and 115.80-116.26 Kg/ha in the beginning and end of the study, respectively. Similarly, at 50-100cm zone of soil no significant difference was observed in available potassium of soil at the beginning as well as at the end of the experiment. However, the available potassium of soil ranged from 76.75-78.04 Kg/ha and 78.82-81.09 Kg/ha in the beginning and end of the study, respectively. The properties of littoral sand like pH at 0-50cm & 50-100cm depth, organic carbon content at 0-50cm depth and nutrient aspect of the soil like nitrogen, phosphorus and potassium at both the depths was hardly influenced by hybrid coconut cultivation, but electrical conductivity varied significantly at both the depths of rhizosphere, which may be attributed to the accumulation of salts in those zones and seepage of water due to poor water retention capacity of the littoral sandy soil. This finding is in line with Minhal *et al.* (2020); Fibrianty *et al.* (2019). The significant changes in soil electrical conductivity (EC) suggest the need for monitoring and managing soil salinity under hybrid coconut cultivation. This may include appropriate irrigation techniques, drainage systems, and the selection of coconut varieties with better salt tolerance. Although no significant changes in soil pH, organic carbon, or NPK content were observed, proper soil fertility management practices, such as nutrient optimization and organic matter incorporation, should be employed to maintain soil health and sustain crop productivity.

Table 1: Changes in pH of the littoral sand.

Germplasm	pH at 0-50 cm depth		pH at 50-100 cm depth	
	in the start of experiment	in the end of experiment	in the start of experiment	in the end of experiment
V1- LCOT × COD	5.83	5.74	5.82	5.91
V2- WCT × MYD	5.87	5.81	5.83	5.96
V3- GBGD × PHOT	5.81	5.83	5.69	5.98
V4- GBGD × ECT	5.88	5.93	5.73	6.06
V5- ECT × MYD	5.69	5.64	5.64	5.77
V6- ECT × GBGD	5.79	5.87	5.61	6.00
V7- ECT	5.82	5.85	5.69	5.97
V8- COD × WCT	5.78	5.72	5.74	5.78
V9- LCOT	5.9	5.86	5.84	5.90
V10- PHOT × GBGD	5.87	5.9	5.74	5.94
V11- MYD × ECT	5.78	5.72	5.74	5.76
V12- LCOT × GBGD	5.76	5.81	5.61	5.85
V13- WCT × COD	5.74	5.68	5.70	5.72
V14- WCT × GBGD	5.85	5.88	5.72	5.89
SE(m)±	0.21	0.19	0.21	0.22
C.D. (0.05)	NS	NS	NS	NS

Table 2: Changes in electrical conductivity of the littoral sand.

Germplasm	EC (dS/m) at 0-50 cm depth		EC (dS/m) at 50-100 cm depth	
	in the start of experiment	in the end of experiment	in the start of experiment	in the end of experiment
V1- LCOT × COD	0.007	0.006	0.008	0.007
V2- WCT × MYD	0.005	0.005	0.006	0.007
V3- GBGD × PHOT	0.005	0.006	0.006	0.008
V4- GBGD × ECT	0.006	0.007	0.007	0.007
V5- ECT × MYD	0.006	0.006	0.007	0.006
V6- ECT × GBGD	0.006	0.005	0.007	0.007
V7- ECT	0.005	0.006	0.006	0.006
V8- COD × WCT	0.007	0.005	0.008	0.008
V9- LCOT	0.007	0.007	0.008	0.007
V10- PHOT × GBGD	0.006	0.006	0.007	0.006
V11- MYD × ECT	0.006	0.005	0.007	0.008
V12- LCOT × GBGD	0.007	0.007	0.008	0.007
V13- WCT × COD	0.005	0.006	0.006	0.006
V14- WCT × GBGD	0.007	0.005	0.008	0.008
SE(m)±	0.0002	0.0002	0.0008	0.0003
C.D. (0.05)	0.0007	0.0007	0.0003	0.0007

Table 3: Changes in organic carbon of the littoral sand.

Germplasm	OC (g/Kg) at 0-50 cm depth		OC (g/Kg) at 50-100 cm depth	
	in the start of experiment	in the end of experiment	in the start of experiment	in the end of experiment
V1- LCOT × COD	2.66	2.76	1.76	1.82
V2- WCT × MYD	2.42	2.57	1.58	1.66
V3- GBGD × PHOT	2.53	2.45	1.64	1.68
V4- GBGD × ECT	2.74	2.63	1.85	1.89
V5- ECT × MYD	2.65	2.75	1.76	1.82
V6- ECT × GBGD	2.75	2.75	1.93	1.96
V7- ECT	2.43	2.60	1.55	1.60
V8- COD × WCT	2.81	2.92	1.87	1.94
V9- LCOT	2.54	2.54	1.77	1.76
V10- PHOT × GBGD	2.45	2.55	1.68	1.60
V11- MYD × ECT	2.62	2.70	1.55	1.84
V12- LCOT × GBGD	2.73	2.74	1.84	1.88
V13- WCT × COD	2.64	2.66	1.75	1.80
V14- WCT × GBGD	2.48	2.52	1.54	1.58
SE(m)±	0.10	0.09	0.06	0.07
C.D. (0.05)	NS	NS	0.18	0.19

Table 4: Changes in available nitrogen of the littoral sand.

Germplasm	Avl. N (Kg/ha) at 0-50 cm depth		Avl. N (Kg/ha) at 50-100 cm depth	
	in the start of experiment	in the end of experiment	in the start of experiment	in the end of experiment
V1- LCOT × COD	113.05	114.12	81.74	84.61
V2- WCT × MYD	113.18	113.67	81.89	84.22
V3- GBGD × PHOT	113.13	114.20	81.80	84.56
V4- GBGD × ECT	113.26	113.90	81.90	84.43
V5- ECT × MYD	113.24	113.84	81.84	84.33
V6- ECT × GBGD	113.47	114.33	82.06	84.65
V7- ECT	113.15	114.17	81.81	84.54
V8- COD × WCT	113.36	114.28	81.98	84.64
V9- LCOT	113.30	113.94	81.93	84.39
V10- PHOT × GBGD	113.08	114.03	81.76	84.51
V11- MYD × ECT	113.21	114.08	81.86	84.48
V12- LCOT × GBGD	113.14	114.19	81.81	84.55
V13- WCT × COD	113.04	114.34	81.73	84.45
V14- WCT × GBGD	113.11	114.23	81.78	84.58
SE(m)±	4.15	4.18	3.00	3.10
C.D. (0.05)	NS	NS	NS	NS

Table 5: Changes in available phosphorus of the littoral sand.

Germplasm	Avl. P (Kg/ha) at 0-50 cm depth		Avl. P (Kg/ha) at 50-100 cm depth	
	in the start of experiment	in the end of experiment	in the start of experiment	in the end of experiment
V1- LCOT × COD	16.17	16.71	12.63	13.15
V2- WCT × MYD	16.38	16.98	12.80	13.37
V3- GBGD × PHOT	16.30	16.82	12.73	13.28
V4- GBGD × ECT	16.50	17.01	12.90	13.50
V5- ECT × MYD	16.66	16.89	12.75	13.47
V6- ECT × GBGD	16.75	17.15	13.17	13.86
V7- ECT	16.33	16.85	12.76	13.32
V8- COD X WCT	16.83	17.31	13.03	13.67
V9- LCOT	16.56	17.07	12.95	13.57
V10- PHOT × GBGD	16.22	16.75	12.67	13.20
V11- MYD × ECT	16.42	16.94	12.84	13.42
V12- LCOT × GBGD	16.31	16.84	12.88	13.30
V13- WCT × COD	16.16	16.69	12.62	13.13
V14- WCT × GBGD	16.47	17.12	12.71	13.25
SE(m)±	0.60	0.62	0.47	0.49
C.D. (0.05)	NS	NS	NS	NS

Table 6: Changes in available potassium of the littoral sand.

Germplasm	Avl. K (Kg/ha) at 0-50 cm depth		Avl. K (Kg/ha) at 50-100 cm depth	
	in the start of experiment	in the end of experiment	in the start of experiment	in the end of experiment
V1- LCOT × COD	114.18	115.94	76.78	78.87
V2- WCT × MYD	114.57	116.04	77.17	79.56
V3- GBGD × PHOT	114.42	115.80	77.02	79.29
V4- GBGD × ECT	114.81	116.10	77.41	79.98
V5- ECT × MYD	114.75	116.09	77.35	79.88
V6- ECT × GBGD	115.11	116.18	77.71	80.51
V7- ECT	114.48	116.01	77.08	79.40
V8- COD × WCT	115.44	116.26	78.04	81.09
V9- LCOT	114.93	116.13	77.53	80.19
V10- PHOT × GBGD	114.27	115.96	76.87	79.03
V11- MYD × ECT	114.66	116.06	77.26	79.72
V12- LCOT × GBGD	114.45	116.01	77.05	79.35
V13- WCT × COD	114.15	115.93	76.75	78.82
V14- WCT × GBGD	114.36	115.98	76.96	79.19
SE(m)±	4.20	4.25	2.83	2.91
C.D. (0.05)	NS	NS	NS	NS

CONCLUSIONS

The study demonstrates that hybrid coconut cultivation does not significantly influence soil properties in littoral sand environments. The cultivation of hybrid coconut palms resulted in significant variation in electrical conductivity and organic matter accumulation at 50-100cm depth. These findings have important implications for sustainable coconut cultivation and soil management practices. Proper utilization of these results can lead to improved productivity, enhanced soil fertility, and the long-term sustainability of coconut farming in coastal regions emphasizing the need for soil salinity management and adoption of appropriate farming practices to ensure long-term productivity and environmental sustainability.

FUTURE SCOPE

Further research is warranted to explore long-term effects and develop sustainable practices for hybrid coconut cultivation in coastal regions.

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Conflict of Interest. None.

REFERENCES

Anil Kumar, K. S. and Wahid, P. A. (1989). Impact of long term inorganic fertilization on soil nutrient availability and nutrition of coconut palm. *Oleagineux, 44*(6), 281-284.

Coconut Development Board. Annual Report, Ministry of Agriculture and Farmer Welfare, Government of India, Kochi, India; 2019-20.

Fibrianty, A. Ma'as, Hanudin, E. and Sudira, P. (2019). Water use efficiency and yield of shallot on coastal sandy soil ameliored by clay and biopolymer. *IOP Conf. Ser.: Earth Environ. Sci.*, *393*, 012061.

Jackson, M. L. (1973). Soil Chemical Analysis, Prentice Hall of India (Pvt.) Ltd., New

Kushwah, B. L., Nelliat, E. V., Markose, V. T. and Sunny, A. F. (1973). Rooting pattern of coconut. *Indian Journal of Agronomy*, *18*, 71-74.

Maheswarappa, H. P., Subhramanian, P. and Dhanpal, R. (2000). Root distribution pattern of coconut (*Cocos nucifera* L.) in littoral sandy soil. *Journal of Plantation Crops*, *28*(2), 164-166.

Minhal, F., Ma'as, A., Hanudin, E. and Sudira, P. (2020). Improvement of the chemical properties and buffering capacity of coastal sandy soil as affected by clays and organic by-product application. *Soil & Water Research, 15*(2) 93-100.

Piper, C. S. (1966). *Soil and plant analysis*, Hans Publishers, Bombay, India.

Reddy, D. V. S. and Upadhyay, A. K. (2002). Impact of integrated nutrient management on the mineral nutrition and yield of WCT coconut in littoral sandy soil at Kasaragod. (In) Proceedings of PLACROSYM-XV, Central Coffee Research Station, Balehonnur, Karnataka, pp. 274-81.

Reddy, D. V. S., Biddappa, C. C., Gopalasundaram, P., Upadhyay, A. K. and Zavier, T. V. (1999). Long term effect of graded fertilizer levels on the productivity of WCT coconut in littoral sandy soil of Kasaragod. *Journal of Plantation Crops, 27*(3), 201-206.

Sahoo, S. C. and Maheswarappa, H. P. (2020). Plant health management in coconut grown in littoral sandy soil of Odisha. *Indian Coconut Journal, 2,* 23-26.

Subbiah, B. V. and Asija, G. J. (1956). A rapid method for estimation of available nitrogen in soils. *Current Science, 25,* 259-260.

Subramanian, P. S., Dhanpal, R., Palaniswami, C., Maheswarappa, H. P., Gupta Alka and Thomas, George, V. (2009). Coastal sandy soil management for higher coconut productivity. Technical Bulletin No. 29. CPCRI, Kasaragod, 20 p.

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