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Evaluation of Husk properties of Hybrid Coconut (*Cocos nucifera*) cultivated in Littoral Sandy Soil of Odisha

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ABSTRACT: An experiment was conducted at Coconut Research Station, Konark, Odisha to evaluate the husk properties of hybrid coconut (*Cocos nucifera*) cultivated in 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. The husk of the coconut is an important by product with numerous potential applications in various industries. This study involved a comprehensive analysis of the physical characteristics of the coconut husk to assess its potential for various industrial applications. The maximum average husk thickness was observed in MYD × ECT (2.99 cm) and the maximum husk weight was recorded in ECT (903.40 g per nut). The maximum husk thickness from proximal end was found in GBGD × ECT (7.09 cm). The maximum husk thickness from distal end was found in COD × WCT (4.31 cm). The maximum husk thickness from thick side was found in MYD × ECT (2.99 cm) and the maximum husk thickness from thin side was found in MYD × ECT (2.01 cm). It was also revealed from the experiment that at the pedicel-end and the apex-end coconuts were found to be thicker. But, at the centre, coconut husk was found to be thinner. This would help in deciding the minimum length of the piercing end of any coconut husking tool. The evaluation of husk properties of hybrid coconuts grown in littoral sandy soil of Odisha demonstrates their suitability for a range of industrial applications.

Keywords: Coconut husk, hybrid coconuts, littoral sandy soil, Odisha, physical properties, industrial applications.

INTRODUCTION

The coconut palm (*Cocos nucifera*) is widely cultivated in the coastal regions of Odisha, India, owing to its economic and ecological importance. Apart from its nutritional value and uses in the food industry, the coconut also produces various by products, including the husk, which has gained attention due to its potential applications in multiple industries. Husk or mesocarp (fleshy middle layer) is composed of fibers called coir. Inner stone or endocarp (outside shell), is the hardest part of the nut which has three germination pores that are clearly visible on the outside surface once the husk is removed. The radicle emerges through one of these germination pores when the embryo germinates. Adhering to the inside wall of the endocarp is the testa, with a thick albuminous endosperm (the coconut "meat"), the white and fleshy edible part of the seed. The shell and husk become harder with maturity. The shell has three germination pores (stoma) or eyes that are clearly visible on its outside surface once the husk is removed (Gibson 1999). A thin brown layer (testa) separates the shell from the endosperm (kernel, flesh, meat), which is approximately 1–2 cm thick. A cavity within the kernel contains the coconut water (Canapi *et al.* 2005). A full-sized coconut weighs about 1.44 kg (3.2 lb). It takes around 6000 full-grown coconuts to produce a tone of copra (Bourke and Harwood 2009). By the time the coconut naturally falls, the husk has become brown, the coir has become drier and softer, and the coconut is not damaged when it drops. This research focuses on evaluating the physical properties of husk of hybrid coconuts grown in littoral sandy soil of Odisha.

MATERIALS AND METHODS

The present 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 planted in 1991 at a spacing of 7.5m × 7.5m. Husk thickness refers to the thickness of the mesocarp (husk) from the epidermis to the endocarp (shell). Husk thickness at various positions i.e., at the pedicel end, center (thick and thin side) and apex end was measured using Vernier height gauge of least count 0.002 inch and the husk removed from same mature nuts were weighed in electronic balance and their average weight was worked out and expressed in gram.

RESULTS AND DISCUSSION

It was revealed from Table 1 that in 1st year, maximum husk thickness from proximal end was found in GBGD × ECT (6.95 cm) which was found significantly higher than all of the other genotypes and was followed by WCT × COD (6.09 cm) and ECT (5.92 cm) and minimum was recorded in WCT × GBGD (3.24 cm). From 2nd year data it was found that, maximum husk thickness from proximal end was found in GBGD × ECT (7.09 cm) which was found significantly higher than all of the other genotypes and was followed by WCT × COD (6.22 cm) and ECT (5.80 cm) and minimum was recorded in WCT × GBGD (3.37 cm). Similarly, from pooled data it was found that, maximum husk thickness from proximal end was found in GBGD × ECT (7.09 cm) which was found significantly higher than all of the other genotypes and minimum was recorded in WCT × GBGD (3.31 cm). It was also revealed from Table 1 that in 1st year, maximum husk thickness from distal end was found in MYD × ECT (4.30 cm) which was found to be statistically on par with COD × WCT (4.22 cm), GBGD × PHOT (3.99 cm) & PHOT × GBGD (3.87 cm) and minimum was recorded in ECT × GBGD (2.51 cm). The maximum husk thickness from distal end was found in COD × WCT (4.39 cm) which was found to be statistically on par with MYD × ECT (4.12 cm), GBGD × PHOT (3.83 cm), ECT × MYD (3.80 cm), LCOT (3.79 cm) & PHOT × GBGD (3.87 cm) and minimum was recorded in ECT × GBGD (2.72 cm) in 2nd year. Similarly, from pooled data it was found that, maximum husk thickness from distal end was found in COD × WCT (4.31 cm) which was found to be statistically on par with MYD × ECT (4.21 cm) and GBGD × PHOT (3.91 cm) and minimum was recorded in ECT × GBGD (2.62 cm). Table 2 represents the husk thickness from thick side and from 1st year data it was found that, maximum husk thickness from thick side was found in MYD × ECT (3.29 cm) which was found significantly higher than all of the other genotypes and was statistically on par with WCT × MYD (2.98 cm) and minimum was recorded in GBGD × PHOT (1.77 cm). The maximum was found in LCOT × COD (2.76 cm) which was found significantly higher than all of the other genotypes and was statistically on par with MYD × ECT (2.69 cm), WCT × MYD (2.44 cm) & ECT × MYD (2.43 cm) and minimum husk thickness from thick side was recorded in GBGD × PHOT (1.44 cm) in 2nd year. Similarly, from pooled data it was found that, maximum husk thickness from thick side was found in MYD × ECT (2.99 cm) which was found significantly higher than all of the other genotypes and minimum was recorded in GBGD × PHOT (1.61 cm). Also, Table 2 represents the husk thickness from husk thickness from thin side and from 1st year data it was found that, maximum husk thickness from thin side was found in MYD × ECT (2.21 cm) which was found statistically on par with ECT (1.97 cm) and minimum was recorded in LCOT × GBGD (1.08 cm). The maximum husk thickness from thin side was found in LCOT × COD (2.10 cm) and COD × WCT (2.10 cm) which was found to be statistically on par with WCT × COD (2.08 cm), ECT × GBGD (1.86 cm) & MYD × ECT (1.80 cm) and minimum was recorded in LCOT × GBGD (1.33 cm) in 2nd year. Similarly, from pooled data it was found that, maximum husk thickness from thin side was found in MYD × ECT (2.01 cm) which was found to be statistically on par with LCOT × COD (1.91 cm) and COD × WCT (1.91 cm) & WCT × COD (1.90 cm) and minimum was recorded in LCOT × GBGD (1.21 cm). It was revealed from table 3 that in 1st year of study, significantly maximum husk thickness was observed in MYD × ECT (3.29 cm) which was statistically on par with WCT × MYD (2.98 cm) and the minimum husk thickness was recorded in ECT × GBGD (1.63 cm). From 2nd year data it was found that, the maximum husk thickness was recorded in LCOT × COD (2.76 cm) which was statistically on par with MYD × ECT (2.69 cm), WCT × MYD (2.44 cm) & ECT × MYD (2.43 cm) and the minimum husk thickness was recorded in GBGD × PHOT (1.44 cm). Similarly, from pooled data it was also found that, maximum husk thickness was observed in MYD × ECT (2.99 cm) which was significantly higher than all of the other genotypes and the minimum husk thickness was recorded in GBGD × PHOT (1.61 cm). The data depicted in Table 3 on husk weight of coconut germplasm reflected significant variations. The maximum husk weight was recorded in ECT (903.40 g, 885.28 g and 894.34 g per nut) and the minimum husk weight (442.84 g, 464.96 g and 453.90 g per nut) was observed in LCOT × GBGD after first and second year of investigation as well as in pooled data respectively. Having high husk thickness might be attributed to the transfer of inherited characters from tall male parent. The result was in line with Varghese *et al.* (2016); Balakrishnan and Kannan (1991); Indiresh *et al.* (1997; Ratnambal *et al.* (2000). This finding suggests that genetic factors play a crucial role in determining husk thickness in coconuts. Further research is warranted to explore the specific genes and genetic mechanisms underlying husk thickness in different coconut varieties. The increase in husk weight might be due to the linear increase in length, width and weight of nut. Further, the declining trend in whole nut weight from tender to mature stage could be attributed to the early maturity of nut as the advancement in maturity reduces the husk weight. Similar observations were also reported by Suchithra and Paramaguru (2019); Manna *et al.* (2002); Vanaja and Sreekumari (1997); Markose *et al.* (1999); Ratnambal *et al.* (2000).

Table 1: Thickness of husk from proximal and distal end of coconut germplasm grown in littoral sandy soil.

Germplasm	Husk thickness from proximal end (pedicel) (cm)			Husk thickness from distal end (apex) (cm)		
	1st year	2nd year	Pooled	1st year	2nd year	Pooled
V1- LCOT × COD	5.00	5.21	5.11	3.41	3.61	3.51
V2- WCT × MYD	5.05	4.85	4.95	3.10	2.91	3.01
V3- GBGD × PHOT	3.89	3.73	3.81	3.99	3.83	3.91
V4- GBGD × ECT	6.95	7.23	7.09	2.91	3.19	3.05
V5- ECT × MYD	4.69	4.89	4.79	3.61	3.80	3.71
V6- ECT × GBGD	5.01	5.21	5.11	2.51	2.72	2.62
V7- ECT	5.92	5.68	5.80	3.41	3.17	3.29
V8- COD × WCT	4.02	4.19	4.11	4.22	4.39	4.31
V9- LCOT	4.12	4.28	4.20	3.63	3.79	3.71
V10- PHOT × GBGD	4.09	3.93	4.01	3.87	3.71	3.79
V11- MYD × ECT	4.60	4.42	4.51	4.30	4.12	4.21
V12- LCOT × GBGD	3.72	3.87	3.80	2.87	3.03	2.95
V13- WCT × COD	6.09	6.34	6.22	3.40	3.64	3.52
V14- WCT × GBGD	3.24	3.37	3.31	3.54	3.68	3.61
SE(m)±	0.30	0.29	0.21	0.21	0.24	0.16
C.D. (0.05)	0.85	0.84	0.58	0.61	0.70	0.44

Table 2: Thickness of husk from thick and thin side of coconut germplasm grown in littoral sandy soil.

Germplasm	Husk thickness from thick-side (cm)			Husk thickness from thin-side (cm)		
	1st year	2nd year	Pooled	1st year	2nd year	Pooled
V1- LCOT × COD	2.25	2.76	2.51	1.72	2.10	1.91
V2- WCT × MYD	2.98	2.44	2.71	1.44	1.17	1.31
V3- GBGD × PHOT	1.77	1.44	1.61	1.75	1.44	1.60
V4- GBGD × ECT	1.80	2.19	2.00	1.36	1.66	1.51
V5- ECT × MYD	1.99	2.43	2.21	1.35	1.66	1.51
V6- ECT × GBGD	1.63	2.00	1.82	1.53	1.86	1.70
V7- ECT	2.41	1.98	2.20	1.97	1.61	1.79
V8- COD × WCT	1.81	2.21	2.01	1.72	2.10	1.91
V9- LCOT	1.88	2.30	2.09	1.37	1.67	1.52
V10- PHOT × GBGD	1.89	1.54	1.72	1.54	1.26	1.40
V11- MYD × ECT	3.29	2.69	2.99	2.21	1.80	2.01
V12- LCOT × GBGD	1.72	2.10	1.91	1.08	1.33	1.21
V13- WCT × COD	1.80	2.21	2.01	1.71	2.08	1.90
V14- WCT × GBGD	1.71	2.08	1.90	1.44	1.77	1.61
SE(m)±	0.14	0.13	0.10	0.11	0.11	0.08
C.D. (0.05)	0.40	0.38	0.26	0.32	0.31	0.21

Table 3: Husk characteristics of different hybrid coconut germplasms grown in littoral sandy soil.

Germplasm	Husk thickness (cm)			Husk weight (g)		
	1st year	2ndyear	Pooled	1st year	2nd year	Pooled
V1- LCOT × COD	2.25	2.76	2.51	621.02	646.15	633.58
V2- WCT × MYD	2.98	2.44	2.71	553.05	529.93	541.49
V3- GBGD × PHOT	1.77	1.44	1.61	772.27	751.15	761.71
V4- GBGD × ECT	1.80	2.19	2.00	706.11	724.22	715.16
V5- ECT × MYD	1.99	2.43	2.21	561.96	567.06	564.51
V6- ECT × GBGD	1.63	2.00	1.82	636.04	677.18	656.61
V7- ECT	2.41	1.98	2.20	903.40	885.28	894.34
V8- COD × WCT	1.81	2.21	2.01	731.18	742.24	736.71
V9- LCOT	1.88	2.30	2.09	449.85	487.99	468.92
V10- PHOT × GBGD	1.89	1.54	1.72	788.29	730.12	759.20
V11- MYD × ECT	3.29	2.69	2.99	612.11	592.99	602.55
V12- LCOT × GBGD	1.72	2.10	1.91	442.84	464.96	453.90
V13- WCT × COD	1.80	2.21	2.01	532.90	548.05	540.47
V14- WCT × GBGD	1.71	2.08	1.90	460.86	484.98	472.92
SE(m)±	0.14	0.13	0.10	36.93	36.88	26.10
C.D. (0.05)	0.40	0.38	0.26	107.35	107.23	72.69

CONCLUSIONS

For designing new innovative husking mechanisms, it is important to know the physical and mechanical properties of coconut. The study revealed that there was a significant difference in husk thickness at different positions of the coconut. This difference was found to be present at the pedicel-end, center and the apex-end. At the pedicel-end and the apex-end coconuts were found to be thicker. But, at the centre, coconut husk was found to be thinner. This would help in deciding the minimum length of the piercing end of any coconut husking tool. The evaluation of husk properties of hybrid coconuts grown in littoral sandy soil of Odisha demonstrates their suitability for a range of industrial applications. The physical characteristics indicate potential uses in composite materials, paper and pulp industries, biofuel production, and soil amendment. These findings contribute to sustainable utilization of coconut byproducts, thereby enhancing the economic value of coconut cultivation in Odisha and promoting a circular economy. Further research is recommended to explore processing techniques, optimization of husk properties, and pilot-scale trials for specific industrial applications, thereby enhancing the economic and environmental sustainability of the coconut industry in Odisha.

FUTURE SCOPE

Further research is warranted to explore the specific applications of mature husks and optimize their utilization in various industries.

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Conflict of Interest. None.

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