



Changes in Physical Characters of Coconut during the Germination Phases

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ABSTRACT

The coconut (*Cocos nucifera*) seed germinates slowly, taking even up to 4 months before the shoot appears. During the germination process of coconut, the nut undergoes several changes in its physical characteristics along with development of coconut haustorium that helps in the mobilization of nutrients during germination. The present research focused on studying the physical changes occurring in coconut seed during germination process starting from the 10th week to the 20th week of germination and the results indicated that coconut undergoes significant changes in physical characteristics of the nut viz. longitudinal and transverse diameter of whole nut and dehusked nut, husk characteristics, nut weight and haustorium weight, which need to be understood for proper assimilation of germination process of coconut seed.

Key Words: Coconut haustorium, Germination phases, Physical characters, Nut characters.

INTRODUCTION

Coconut (*Cocos nucifera* L.) is a valuable and vital perennial plant that plays an essential role in the socio-economic and cultural activities of millions of people in our country. Coconut is called as the “tree of life” since every part of the plant is useful (Atinmo *et al*, 2003). With great versatility, coconut provides a bountiful source of food, household products and income for millions of small holder farmers around the world. Apart from the importance of copra and coconut oil which is widely used in the manufacture of soaps, hair oil, cosmetics and other industrial products, its husk is a source of fibre which supports a sizable coir industry. The tender nut supplies coconut water, a popular thirst quencher of health and hygienic value. Virgin coconut oil (VCO), extracted from fresh coconut kernel without any chemical processes is

abundant in vitamins, minerals and anti-oxidants, thus making it the ‘mother of all oils’ (Samosir *et al*, 2006).

Coconut farming is currently facing many challenges including palm senility, devastating abiotic and biotic stresses, market instability of its products and the insufficient production of seedlings to replant the ageing palms. Proper knowledge about coconut germination process and associated changes is critical for quality seedling production. Considering the poor germination and time taken to achieve higher percentage of germination of several market-demanded coconut varieties, it is important to understand the changes associated with germination of coconut as it will substantially contribute to global demand for good quality coconut seedlings (Leach *et al*, 2003). One of the principal changes occurring during the germination

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process of coconut is the development of haustorium or coconut apple, which mobilizes nutrients from endosperm to nourish the germinating embryo (Sangamithra *et al*, 2013). It is inferred that the coconut germination process is poorly understood and future research needs to focus on the changes during germination of coconut seed (Baskin and Baskin, 2014). Hence the study was undertaken to analyse the physical changes that occur in coconut during its germination phases.

MATERIALS AND METHODS

Mature nuts (11 to 12 months) from pre-identified palms of coconut variety West Coast Tall (WCT) were collected and sowed in a horizontal plain covering two-third of each nut with soil. Moisture was maintained by periodical watering. Changes in the physical characters of nut and haustorium weight were analyzed during the germination phases starting from 10 to 20 weeks of nut sowing at two weeks intervals. The design of the experiment followed was CRD. Physical characters (shape, colour, longitudinal diameter of whole nut, transverse diameter of whole nut, longitudinal diameter of dehusked nut, transverse diameter of dehusked nut, husk thickness, husk weight, nut weight) and haustorium weight were determined based on the following procedures. The data obtained were statistically analysed using Analysis of Variance ($p=0.05$) with Completely Randomised Design.

Shape (whole nut)

The shape of the nuts before dehusking was recorded as per the descriptors for coconut by IPGRI (1992). The shape of the individual nut was categorized into pointed, ovoid, round and oblate.

Colour (whole nut)

The colour of the nut was recorded by developing a colour chart which categorizes the nuts based on three different colours *viz.*, brown, brownish black and black.

Longitudinal diameter of whole nut (cm)

The longitudinal diameter of whole nut was determined as per the procedure of Li *et al.* (2019) by measuring the longitudinal curve of the individual nut from the distal end to the proximal end and expressed in cm.

Transverse diameter of whole nut (cm)

The transverse diameter of whole nut was recorded as per the procedure of Li *et al.* (2019) by measuring the transverse curve of the individual nut at the broadest midpoint of each nut and expressed in cm.

Longitudinal diameter of dehusked nut (cm)

The longitudinal diameter of dehusked nut was determined as per the procedure of Li *et al.* (2019) by measuring the longitudinal curve of the individual nut from the distal end to the proximal end and expressed in cm.

Transverse diameter of dehusked nut (cm)

The transverse diameter of dehusked nut was recorded as per the procedure of Li *et al.* (2019) by measuring the transverse curve of the individual nut at the broadest midpoint of each nut and expressed in cm.

Husk thickness (cm)

Collected nuts were de-husked, and thickness of the husk was estimated using a vernier calliper and expressed in cm.

Husk weight (g)

After de-husking, husk weight was recorded in an electronic weighing balance (Cyber Lab-0.01mg to 1000g) and expressed in gram.

Nut weight (g)

The weight of dehusked nut was determined by weighing the individual nut on an electronic weighing balance and expressed in gram.

Haustorium Weight (g/ nut)

The germinated nuts were dehusked, deshelled and the haustorium was extracted carefully without

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damage. It was weighed on a balance (Cyber Lab-0.01mg to 1000g) and expressed in gram.

RESULTS AND DISCUSSION

Physical characters of nut (shape, colour, longitudinal diameter of whole nut, transverse diameter of whole nut, longitudinal diameter of dehusked nut, transverse diameter of dehusked nut, husk thickness, husk weight, nut weight) and haustorium weight varied significantly with the progress of germination phases (Table 1).

The shape of the whole coconut did not show any distinct variation between the germination phases and was recorded as oblate in all the growth stages. The colour of the whole nuts was recorded as brownish black in all the developmental phases and there was no noticeable difference in the colour. The longitudinal diameter of whole nut varied between 53.00 cm and 54.74 cm and transverse diameter of whole nut ranged from 50.04 cm to 51.72 cm with no significant difference statistically between the growth phases.

The longitudinal diameter of dehusked nut also showed no significant difference among the development phases and it ranged between 31.90 cm to 32.92 cm. The transverse diameter of dehusked nut varied between 31.26 cm and 33.72 cm with no statistically significant difference among the different germination phases of coconut.

Husk thickness exhibited a decreasing trend with the advancement of growth stages and it ranged between 3.30 cm to 3.56 cm even though the difference was found to be statistically non-significant. Husk weight showed a decreasing trend with the increase in growth phases which ranged from 746.78 g to 752.06 g but the changes in husk weight were statistically found to have no significant difference among the germination weeks. In the present study, husk thickness and husk weight were found to have no significant changes with respect to different germination phases and the results are in conformity with the findings of Arivalagan *et al* (2018).

Table 1. Physical characters of nut and haustorium with germination phases of coconut

Growth phases	T1: 10 th week	T2: 12 th week	T3: 14 th week	T4: 16 th week	T5: 18 th week	T6: 20 th week	SE(±m)	CD (0.05)
Shape	Oblate	Oblate	Oblate	Oblate	Oblate	Oblate	-	-
Colour	Brownish black	Brownish black	Brownish black	Brownish black	Brownish black	Brownish black	-	-
Longitudinal diameter of whole nut (cm)	54.68	54.56	54.74	53.60	53.00	53.24	0.599	NS
Transverse diameter of whole nut (cm)	51.02	50.26	51.72	51.14	50.04	51.30	1.813	NS
Longitudinal diameter of husked nut (cm)	31.90	32.22	32.42	32.80	32.92	32.90	0.544	NS
Transverse diameter of husked nut (cm)	33.64	31.26	31.70	32.48	32.56	33.72	0.648	NS
Husk thickness (cm)	3.56	3.50	3.48	3.46	3.42	3.30	0.122	NS
Husk weight (g)	752.06	750.62	749.64	748.76	747.22	746.78	11.578	NS
Nut weight (g)	366.00 ^c	399.40 ^d	456.71 ^c	505.71 ^b	546.41 ^a	549.33 ^a	10.589	32.628
Haustorium weight (g/nut)	50.33 ^c	66.19 ^{dc}	79.07 ^d	115.86 ^c	174.47 ^b	202.30 ^a	5.345	16.469

The nut weight of dehusked coconut increased with the advancement of germination of coconut from 366.00 g after the 10th week of nut sowing to 549.33 g after the 20th week of nut sowing. There was no significant increase in nut weight between 18th and 20th week of development stages. This might be due to the formation of haustorium expands that filled the entire water cavity to nourish germinating embryo as reported by Arivalagan *et al* (2018). The nut weight in the present study showed an increasing trend with growth phases, where the highest increase of 14.34% was observed for nuts between the 12th and 14th week of germination and the lowest percentage increase was observed for nuts between the 18th and 20th week of germination which clearly indicated that the haustorium enlargement occurs faster during the early stages so as to cover the entire cavity and later on, it transports nutrients from the endosperm to the young seedling for enhancing growth.

Haustorium weight increased with the growth stages where the nuts at 20th week recorded the highest weight of 202.3g and the 10th week recorded the lowest haustorium weight of 50.33g. The percentage increase in haustorium weight was highest (46.53%) during the interval between the 14th and 16th week of germination and lowest increase (15.95%) was recorded during the 18th and 20th week of germination. Results were in accordance with the findings of International Federation for the Advancement of Science (IFAS, 2000) where haustorium took around four months to enlarge and cover the entire nut cavity. Arivalagan *et al* (2018) confirmed that the amount of haustorium extracted in the germinated nut ranged from 80.2 g to 131 g with a mean value of 107g. Similar observations were also noticed by Li *et al* (2019), where haustorium enlarged and completely filled the entire space of the nut by about 4.5 months after germination.

CONCLUSION

Even though there has been much global research on coconuts, many fundamental details of the germination of coconut seeds are still unclear.

The physical changes occurring in coconut seed during germination process starting from the 10th week of germination to the 20th week of germination *viz.* shape and colour of whole nut, longitudinal and transverse diameter of whole nut, longitudinal and transverse diameter dehusked nut, husk thickness, husk weight, nut weight and haustorium weight were analysed. The study revealed major changes occurring in physical characteristics of coconut with respect to different phases of germination. The longitudinal and transverse diameter of whole nut varied between 53.00 cm and 54.74 cm and 50.04 cm to 51.72 cm whereas the longitudinal and transverse diameter of dehusked ranged from 31.90 cm to 32.92 cm and 31.26 cm and 33.72 cm respectively. Husk thickness ranged from 3.30 cm to 3.56 cm and husk weight varied from 746.78 g to 752.06 g with a nut weight between 366.00 g and 549.33 g and haustorium weight ranging from 50.33g to 202.3g across the germination phases of coconut.

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