



Variability and heterosis in spathe traits of coconut (*Cocos nucifera* L.)

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Coconut is an important crop of tropics, which sustains livelihood of many farm families. In coconut, spathe plays very essential role in safeguarding the inflorescence. Spathe serves the palm as the first protective mechanism of the reproductive system (Uhl and Moore, 1973). Dimensions of spathe are also found to be important discriminating feature of typical, nana and javonica groups of coconut cultivars (Sugimura *et al.*, 1997). Inflorescence spathe of coconut palms is rich in energy (biomass recycling) (Baboo and Ramadasan, 1986). They can also be used as substrate for mushroom cultivation (Thomas *et al.*, 1998). Spathe is used for making special containers especially by inflorescence tappers. In commercial practice, spathe is immersed for overnight in water and then made into thin strips (0.5cm width). These stripes are used for making thatch or making fence as a rope. This is a substitute for the coir rope because it has good strength and low degrading property. Heterosis in coconut has been exploited as early as 1937 by Patel for collar girth, number of leaves and seedling vigour. Heterosis also has been exploited for yield (Ramanathan, 1989; Damodaran *et al.*, 1991) and identifying seedlings vigour (Louis and Chopra., 1988). Coconut palms bearing multiple spathes to cover a single inflorescence have been reported (Arunachalam *et al.*, 2001). The present study was done to analyze the variability and heterosis for four important traits of inflorescence spathe in sixteen hybrids and their ten parents (25 to 30 years old). The location of the experiment was conducted during 2005-2008 at Coconut Research Station, Veppankulam, Tamil Nadu under the All India Co-ordinated Research Project on Palms.

Three palms were selected for each hybrids and parents for this study. From each palm one spathe of

three month-old bunches was carefully removed without damage using a sharp knife and used for recording the observations. The spathe length was measured from the base to tip at three places (centre, left and right). The width of the spathe was measured at three places (base, middle and tip) and mean value was worked out. The thickness was recorded with screw gauge in three locations. Dendrogram was constructed using NTSYS 2.0 (Neighbourhood joining method) for spathe traits. Neighbour-joining is a bottom-up clustering method used for the construction of phylogenetic trees.

Among the spathe traits, weight of spathe had recorded high variation among the parents (CV 54 %), while the hybrids showed lesser variability (CV 22 %). Spathe of MGD was very light (173 g) whereas PHOT was very heavy (853 g) in (Table 1 and 2). Spathe weight in hybrids ranged from 217 g in MYD x CGD to 533 g in PHOT x COCT.

Length of spathe varied from 68.5 cm (CGD) to 104.6 cm (LCOT) in parents, whereas in hybrids, it ranged from 73.3 cm (MYD x CGD) to 109.6 cm (PHOT x COCT). Breadth of the spathe varied from 14.16 cm (CGD) to 17.88 cm (LCOT) in parents. But

Table 1. Mean of spathe traits in parents and hybrids

Parents & Hybrids	Weight (g)	Length (cm)	Breadth (cm)	Thickness (cm)
Dwarf	269.98	83.91	16.11	0.33
Tall	420.00	92.83	16.78	0.41
D x D	277.08	81.17	17.15	0.32
T x D	345.82	89.66	17.12	0.42
D x T	383.33	96.25	17.77	0.39
T x T	422.78	99.57	17.78	0.38

Table 2. Spathe traits in parents

Parents	Weight (g)	Length (cm)	Breadth (cm)	Thickness (cm)
MYD (Malayan Yellow Dwarf)	366.60	102.80	17.74	0.47
CGD (Chowghat Green Dwarf)	180.00	68.50	14.16	0.23
AYKT (Ayiramkachi Tall)	226.66	85.00	15.80	0.36
SMT(Siam Tall)	400.00	99.00	16.05	0.56
COCT(Cochin China Tall)	316.66	91.66	16.38	0.35
PHOT(Philippines Ordinary Tall)	853.33	93.33	16.83	0.34
LCOT(Laccadive Ordinary Tall)	423.33	104.66	17.88	0.43
ECT (East Coast Tall)	300.00	83.33	17.71	0.41
GBGD(Gangabondam Green Dwarf)	360.00	93.00	16.60	0.36
MGD(Malayan Green Dwarf)	173.30	71.33	15.94	0.27
Min	173.30	68.50	14.16	0.23
Max	853.33	104.66	17.88	0.56
Mean	359.99	89.26	16.51	0.38
CV %	53.96	13.76	6.85	25.21

in hybrids, it ranged from 14.61 cm (ECT x MGD) to 20.7 cm (MYD x SMT). Spathe thickness in parents registered the lowest value of 0.2 cm in CGD and the highest value of 0.56 cm in Siam Tall. This character showed a range of 0.28 cm to 0.56 cm in the hybrid accessions of MYD x CGD and PHOT x COCT, respectively. (Table 3).

Of the sixteen hybrids studied, ten had showed the negative heterosis ranging from – 9 to – 30. MGD x ECT had recorded high heterosis of 38 % over mid parents for spathe weight, 55 % heterosis over female parent and 22 % over male parent for this trait. This hybrid also showed higher heterosis of 21 % over mid parent for spathe length MGD as male parent with ECT as female parent had showed 16 % of heterosis over mid parent for spathe weight (Table 4). Among the four dwarfs used in the study, MYD was found as potential candidate for spathe traits. The same cultivar used as a parent in the hybrids also exhibited better performance irrespective of acting as male or female. ECT had expressed positive heterosis in four hybrids out of six hybrids used in the study.

In Dendrogram, totally five clusters were obtained for the trait in this study. Among the four dwarfs used, MYD formed distinct cluster. In Tall, PHOT, LCOT, SMT were found to be distinct and formed separate cluster (Fig.1).

Spathe length is one of the important characters which contributes more than – 0.7 score in first factor component in 39 coconut cultivars representing all the three groups (Typica, Javanica and Nana). These three types also differed significantly for spathe length

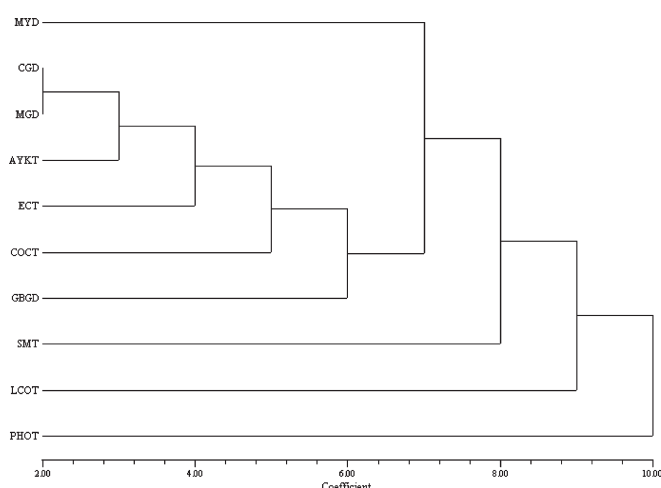
Table 3. Spathe traits of hybrids

Hybrids	Weight (g)	Length (cm)	Breath (cm)	Thickness (cm)
CGD x MYD (Chowghat Green Dwarf x Malayan Yellow Dwarf)	337.50	89.00	16.75	0.35
MYD x CGD (Malayan Yellow Dwarf x Chowghat Green Dwarf)	216.66	73.33	17.55	0.28
AYKT x SMT (Ayiramkachi Tall x Siam Tall)	430.00	97.33	18.28	0.30
SMT x AYKT (Siam Tall x Ayiramkachi Tall)	266.66	88.00	14.94	0.30
MYD x SMT (Malayan Yellow Dwarf x Siam Tall)	450.00	97.33	20.70	0.44
SMT x MYD (Siam Tall x Malayan Yellow Dwarf)	410.00	94.33	20.22	0.42
COCT x PHOT (Cochin China Tall x Philippines Ordinary Tall)	450.00	104.66	17.83	0.42
PHOT x COCT (Philippines Ordinary Tall x Cochin China Tall)	533.33	109.60	18.38	0.56
COCT x LCOT (Cochin China Tall x Laccadive Ordinary Tall)	440.00	98.50	19.35	0.35
LCOT x COCT (Laccadive Ordinary Tall x Cochin China Tall)	416.66	99.33	17.88	0.33
GBGD x ECT (Gangabondam Green Dwarf x East Coast Tall)	400.00	100.00	18.77	0.35
ECT x GBGD (East Coast Tall x Gangabondam Green Dwarf)	383.33	94.33	17.58	0.47
MGD x ECT (Malayan Green Dwarf x East Coast Tall)	383.33	98.00	16.55	0.41
ECT x MGD (East Coast Tall x Malayan Green Dwarf)	283.33	84.33	14.61	0.37
MYD x ECT (Malayan Yellow Dwarf x East Coast Tall)	300.00	89.66	15.07	0.37
ECT x MYD (East Coast Tall x Malayan Yellow Dwarf)	306.60	85.66	16.05	0.42
Min	216.66	73.33	14.61	0.28
Max	533.33	109.60	20.70	0.56
Mean	375.46	93.96	17.53	0.38
CV %	22.20	9.32	10.28	18.76

(Sugimura *et al.*, 1997). Heterosis over mid parent value was positive for most of the Tall x Tall hybrids. The Tall x Tall hybrid PHOT x COCT and its reciprocal hybrid showed higher heterosis for all the spathe characters except spathe weight with higher mean value. MGD x ECT had showed good mean yield performance and heterosis (Jayabose *et al.*, 2008). However, Ramanathan (1989) reported the cross combination ECT x MGD had shown good heterosis for yield characters. MGD is the best female parent for all the four characters studied. MGD x ECT cross combination can be used to evolve a hybrid which could be utilized as a potential candidate for enhancing the spathe traits.

Table 4. Heterosis (%) over mid parent Value

Hybrids	Weight	Length	Breath	Thickness
CGD x MYD (Chowghat Green Dwarf x Malayan Yellow Dwarf)	19	4	5	0
MYD x CGD (Malayan Yellow Dwarf x Chowghat Green Dwarf)	-26	-17	9	-25
AYKT x SMT (Ayiramkachi Tall x Siam Tall)	27	5	13	-53
SMT x AYKT (Siam Tall x Ayiramkachi Tall)	-18	-5	-7	-53
MYD x SMT (Malayan Yellow Dwarf x Siam Tall)	15	-4	18	-17
SMT x MYD (Siam Tall x Malayan Yellow Dwarf)	7	-7	16	-23
COCT x PHOT (Cochin China Tall x Philippines Ordinary Tall)	-30	12	7	18
PHOT x COCT (Philippines Ordinary Tall x Cochin China Tall)	-10	16	10	38
COCT x LCOT (Cochin China Tall x Laccadive Ordinary Tall)	16	0	11	-11
LCOT x COCT (Laccadive Ordinary Tall x Cochin China Tall)	11	1	4	-18
GBGD x ECT (Gangabondam Green Dwarf x East Coast Tall)	18	12	9	-10
ECT x GBGD (East Coast Tall x Gangabondam Green Dwarf)	14	7	2	18
MGD x ECT (Malayan Green Dwarf x East Coast Tall)	38	21	-2	17
ECT x MGD (East Coast Tall x Malayan Green Dwarf)	16	8	-15	8
MYD x ECT (Malayan Yellow Dwarf x East Coast Tall)	-11	-4	-18	-19
ECT x MYD (East Coast Tall x Malayan Yellow Dwarf)	-9	-9	-10	-5

**Fig. 1. Dendrogram of Coconut cultivars for spathe traits**

Tall and dwarf varieties of coconut in this study showed significant difference for spathe weight. In general, Tall cultivars and Tall x Tall hybrids of coconut

are preferred by farmers due to their adaptation and less susceptibility to drought and pests. Inflorescence spathe weight is an important trait, which might have direct role in protecting the inflorescence from pest and disease and also providing living space for many predators could be an indicator for yield increase. In this study, Tall and Tall x Tall hybrids had (450 g) heavy spathes, whereas, dwarf and Dwarf x Dwarf hybrids show light spathe (< 280 g).

PHOT and LCOT parents recorded very heavy spathes, which are also found to be good yielder in different agro-climatic conditions of India (Jayabose, 2007), which is in confirmation with the earlier finding of Ratnambal and Nair (1996). Both these cultivars which have heaviest spathe are also high yielding coconut varieties in India.

However, information on genetics or heterosis of useful traits such as coir, spathe and inflorescence sap is yet to be generated and thus, it will be of interest to know the variability in dimension existing in different cultivars and hybrids of coconut palm. More over study of the variability and heterosis in spathe traits might have positive influence on obtaining superior coconut varieties/hybrids and thus this may be useful in future breeding programme for product diversification.

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