Research Article

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Estimation of heterosis of economical important characters of coconut (*Cocos nucifera* L.) hybrids

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Abstract

The nature and magnitude of heterosis for nut yield, oil content, copra content and kernel weight of coconut were assessed in the F_1 generation of 16 crosses. Hybrids displayed substantial differences in their heterotic response for these characters. Considerable amount of heterosis was observed but its magnitude varied for the characters studied. Hybrids out yielded their better parents for yield in five cases. The highest yielding hybrid excelled its better parent by 109% and followed by its reciprocal by 92 %. A number of top yielding crosses were observed with dwarf parent dwarf especially MYD as either male or female.

Keywords: coconut hybrids, economic heterosis, heterobeltiosis

Introduction

Coconut palm (*Cocos nucifera*. L) exhibits wide variability in productivity ranging from 30 nuts to 400 nuts/palm/year depending on growth conditions and cultivars (Iyer *et al.*, 1981). India was the first country in the world to exploit hybrid vigour in coconut in a cross between tall palms and dwarf palms (Patel, 1937). In the middle of 1950's the major emphasis was on the production of Tall x Dwarf hybrids. Heterosis is the superiority of the hybrid over the mid or better parent as standard variety and is the result of allelic or non-allelic interaction of genes under the influence of particular environments. As the effect of heterosis of yield in particular can vary between sites (Chapman *et al.*, 2000), it is more meaningful to characterise a particular hybrid as showing heterosis for yield at a specific locality or under certain environmental conditions. Meredith and Bridge (1972) coined the term economic heterosis, which is defined as the superiority of a hybrid over a non–hybrid commercial cultivar. The present study was undertaken to identify better hybrids based on heterobeltiosis (superior to better parent) as well as economic heterosis with respect to East Coast Tall (ECT) a commercial cultivar in that region.

Materials and Methods

The present investigation was carried out between June 2004 and February 2006 at the experimental garden of All India Coordinated Research Project on Palms, Coconut Research Station, Veppankulam, Tamil Nadu, India. The experiment was laid out in randomized bock design with six replications. The list of hybrids and parents considered is provided in Table 1. Observations on economically important traits viz., annual nut yield, kernel weight, copra weight and oil content were taken from all the trees included in the study. The age of the trees ranged between 20 and 35 years. For annual nut yield, average value of yield for the period 1995 to 2006 was taken. For other characters, observations on 18 nuts per tree for 10 harvests in the period 2004 to 2006 were taken. The mean values were subjected to statistical analysis. The heterobeltiosis of F_1 hybrids was computed after Fehr (1987) and economic heterosis as per Meredith and Bridge (1972).

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Table 1. List of Hybrids and Parents used in the study

Parents	Hybrids	Code
CGD (Chowghat Green Dwarf)	CGD x MYD	H_1
MYD (Malayan Yellow Dwarf)	MYD x CGD	H_2
AYKT (Ayiramkachi)	AYKT x SIAM	H_3
SIAM (Siam Tall)	SIAM x AYKT	H_4
CCNT (Cochin China Tall)	MYD x SIAM	H_5
PHOT (Philippine Ordinary Tall)	SIAM x MYD	H_6
LCOT (Laccadive Ordinary Tall)	CCNT x PHOT	H_7
GBGD (Gangabondam Green dwarf)	PHOT x CCNT	H_8
ECT (East Coast Tall)	CCNT x LCOT	H_9
MGD(Malayan Green Dwarf)	LCOT x CCNT	H_{10}
	GBGD x ECT	H_{11}
	ECT x GBGD	H_{12}
	ECT x MGD	H_{13}
	MGD x ECT	H_{14}
	MYD x ECT	H_{15}
	ECT x MYD	H_{16}

Results and Discussion

The average values of annual nut yield, kernel weight, copra weight and oil content for the hybrids and parents are shown in Table 2. Analysis of variance revealed that the hybrids/parents were significantly different with respect to all the four characters. The average yield of hybrids ranged between 58.53 (CCNT x PHOT) and 130.20 (MYD x ECT) nuts/year. Three more crosses have nut yield over 100 viz., ECT x MGD; ECT x GBGD and ECT x MYD. In general, the hybrids with ECT as female parent were found to be yield better. Parental yield was the highest for AYKT (129.57) and the lowest was in MYD (18). The CV for this trait was 16.15%.

Kernel weight of hybrids varied from 188.33 g (MGD x ECT) to 334.60 g (CCNT x PHOT). Combinations having high kernel weight (>270 g) include

Table 2. Mean performance of coconut hybrids and parents for nut yield and traits

Hybrids/ Parents	Yield (no. of nuts/year)	Weight of kernel (g)	Weight of copra (g)	Oil content (percent)
CGD x MYD	92.30	264.47	153.55	56.50
MYD x CGD	100.30	227.94	123.34	65.26
AYKT x SIAM	76.23	212.68	123.94	56.22
SIAM x AYKT	102.33	206.18	121.04	63.56
MYD x SIAM	89.27	245.74	141.14	60.66
SIAM x MYD	67.43	297.00	162.21	59.92
CCNT x PHOT	58.53	334.60	181.06	57.55
PHOT x CCNT	72.77	294.62	159.80	61.13
CCNT x LCOT	75.10	252.46	142.51	62.84
LCOT x CCNT	96.17	257.45	154.64	63.29
GBGD x ECT	76.83	237.54	138.19	66.03
ECT x GBGD	106.00	273.07	155.48	60.80
ECT x MGD	123.83	243.23	142.68	62.69
MGD x ECT	78.73	188.33	109.36	61.13
MYD x ECT	130.20	211.00	118.75	55.16
ECT x MYD	104.47	241.72	144.95	54.87
CGD	47.87	129.86	74.15	61.42
MYD	18.90	238.05	121.92	54.95
AYKT	129.57	230.89	134.60	65.30
SIAM	50.40	308.99	183.60	62.65
COCT	85.43	336.51	200.53	70.04
PHOT	66.77	314.49	179.51	62.60
LCOT	103.00	236.29	140.90	50.94
GBGD	94.57	274.36	167.16	50.88
ECT	143.97	243.00	144.56	61.42
MGD	21.83	203.62	117.33	54.95
Mean	85.11	250.16	143.73	60.4588
SEd	23.19	12.926	8.621	0.3731
CD (P = 0.05)	46.59	25.473	16.989	0.7352
CV%	16.15	5.167	5.998	1.38

SIAM x MYD; PHOT x CCNT and ECT x GBGD. Among parents, weight of kernel varied from 129.86 (CGD) to 336.51 (CCNT). The variation for copra weight is similar to that of kernel weight and it ranged between 109.36 g (MGD x ECT) and 181.06 g (CCNT x PHOT) in the case of hybrids while it varied between 74.15 g (CGD) to 200.53 g (CCNT) for parents. Rattanapruk *et al.* (1986) and Meunier *et al.* (1986) has indicated that copra yield per nut was higher in Tall x Tall hybrids. The dwarf cultivar COD was found to be inferior to tall cultivars in copra weight and nut dry weight (Siju, 2003). Lower copra content and low nut yield together lead to low annual copra production in this cultivar. The present study also revealed the low copra weight of dwarf cultivars. Tall x Tall (CCNT x PHOT) hybrid recorded high copra weight per nut.

The oil content varied from 55.16% (MYD x ECT) to 66.03% (GBGD x ECT) in the case of hybrids. For parents, it varied between 54.87% (CGD) to 70.04% (PHOT). The CV for kernel weight and copra weight were observed to be 5.1 and 5.9% and it is the lowest for the oil content (1.38%).

Range of degree of significant heterosis in percent and number of heterotic crosses for respective traits are presented in Table 3. In the present study, five hybrids showed yield superiority over better parent and three of them were significantly high yielding than the best parent.

Heterosis over better parent for yield ranged from -46% to 109. A wide variation was observed for yield in the case of the hybrids and parents in the present study. Among the parents ECT, AYKT, LCOT and CCNT recorded higher yield when compared to other cultivars. Among the hybrids, MYD x ECT was found to be the best performer for yield followed by ECT x MGD. This finding is in confirmation of the findings of Rattanapruk *et al.* (1983). In their study, the hybrids in which MYD was used as maternal parent (MYD x WAT) outperformed the other hybrids. They also opined that the superiority of this hybrid may be due to its parental uniformity. Santos *et al.* (1986) also reported the superiority of MYD x WAT. The present investigation revealed that MYD x ECT stands as the highest yielding hybrid. Its reciprocal ECT x MYD has already been released as VHC– 2 which is a consistent high yielding genotype (Anonymous, 2001). ECT x MYD was found to be a good performer for yield in the present study also. The hybrid MYD x CGD, CGD x MYD, MYD x ECT and ECT x MYD with MYD either as male or female parent were observed to be high yielding. Among the parents, Ayiramkachi (AYKT) was found to be the best yielding genotype. This cultivar is the best performer for number of female flowers and a number of other inflorescence characters among parents. The hybrids AYKT x SIAM and SIAM x AYKT also expressed good performance for yield. This observation is in line with earlier report of Ramachandran *et al.* (1975), who

Table 3. Heterosis for economically important characters in coconut hybrids

Sl.No	Hybrids	Yield		Kernel weight		Copra weight		Oil content	
		Hetero beltiosis (%)	Economic Heterosis (%)	Hetero beltiosis (%)	Economic Heterosis (%)	Hetero beltiosis (%)	Economic Heterosis (%)	Hetero beltiosis (%)	Economic heterosis (%)
H_1	CGD x MYD	92.81*	-35.89*	11.10*	8.84	25.94*	6.22	-8.01*	-8.01*
H_2	MYD x CGD	109.53*	-30.33	-4.25	-6.20	1.16	-14.68*	6.25*	6.25*
H_3	AYKT x SIAM	-41.17*	-47.05*	-31.17*	-12.48*	-32.49*	-14.26*	-13.91*	-8.47
H_4	SIAM x AYKT	-21.02	-28.92	-33.27*	-15.15*	-34.07*	-16.27*	-2.66*	3.48*
H_5	MYD x SIAM	86.48*	-37.99*	-20.47*	1.13	-23.13*	-2.37	-3.18*	-1.24*
H_6	SIAM x MYD	40.86	-53.16*	-3.88	22.22*	-11.65*	12.21*	-4.36*	-2.44*
H_7	CCNT x PHOT	-31.49	-59.35*	-0.57	37.70*	-9.71*	25.25*	-17.83*	-6.30*
H_8	PHOT x CCNT	-14.82	-49.45*	-12.45*	21.24*	-20.31*	10.54	-12.72*	-0.47
H_9	CCNT x LCOT	-12.09	-47.84*	-24.98*	3.89	-28.93*	-1.42	-10.28*	2.31*
H_{10}	LCOT x CCNT	12.57	-33.20*	-23.49*	5.95	-22.88*	22.40*	-9.64*	3.04*
H_{11}	GBGD x ECT	-46.63*	-46.63*	-13.42*	-2.25	-17.33*	-4.41	7.51	7.51*
H_{12}	ECT x GBGD	-26.37	-26.37	-0.47	12.37*	-6.99	7.55	-1.01*	-1.01
H_{13}	ECT x MGD	-13.99	-13.99	0.09	0.09	-1.30	-1.30	2.07*	2.07*
H_{14}	MGD x ECT	-45.31*	-45.31*	-22.50*	-22.50*	-24.35*	-24.35*	-0.47	-0.47
H_{15}	MYD x ECT	-9.56	-9.56	-13.17	-13.17	-17.85*	-17.85*	-10.19*	-10.19*
H_{16}	ECT x MYD	-27.44	-27.44	-0.53	-0.53	0.27	0.27	-10.66*	-10.66*

***Significant at 5% level**

reported superiority of AYKT in the case of inflorescence characters and yield potential.

In the case of kernel weight, only two hybrids H_1 and H_{13} showed positive heterobeltiosis value of 11.10 % and 0.09 %, respectively over the better parent. However, economic heterosis for kernel weight was positive and significant in four hybrids viz., H_6, H_7, H_8 and H_{12} indicating the scope for selection of these hybrids as they are better than the ruling variety ECT.

Significant and positive heterobeltiosis for copra weight was recorded by CGD x MYD (25.94%). Though the value of heterosis is positive, it is not significant for the hybrids MYD x CGD and ECT x MYD. For the rest of the hybrids, negative and significant heterosis was recorded for the character copra weight. Economic heterosis for copra weight was varied from 5% (ECT x GBDG) to 20% (CCNT x PHOT and LCOT x CCNT).

When two different alleles of various genes are brought together, there is a combined allelic expression. And also the complementation of alleles in different genes were cumulative in phenotype, then heterosis would result (James *et al.*, 2003). Similarly in the present study the heterotic expression of hybrids with MYD(distant parent) with CGD exhibited well pronounced heterosis.

Heterosis for oil yield in various crosses between high and low oil content parents was also accompanied, for distinct improvement oil percentage. But lack of pronounced heterosis for this character was observed in the present study. There were no indication of any marked maternal influence on character expression for this trait and hence this is unlikely to impose any serious restriction on the choice of parents as females or males in developing of hybrids for high oil content.

Natarajan *et al.* (2006) also observed heterosis for yield, kernel thickness, and copra yield in the same pattern. In coconut, farmers generally prefer existing or ruling varieties in any region and so it is essential to prove the better performances of hybrids over the local commercial cultivars so that the farmers accept them.

Conculsion

The present study showed that the coconut hybrids behaved differently and revealed varying pattern of heterotic behaviour for four economically important characters. The negative heterosis observed in some crosses may be attributed to non allelic interaction which can either increase (or) decrease the expression of heterosis. Five hybrids studied presently expressed economic heterosis for commercially important characters. The coconut hybrids showing well pronounced heterotic expression could be exploited for development of location specific hybrids of commercial importance.

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