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Study of the crossing of improved tall coconut x improved tall coconut in Côte d'Ivoire

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This study evaluates the crossing between improved tall coconuts through the comparison of agromorphological characteristics between parents and progeny and the study of genetic links. Fourteen agromorphological descriptors were measured on three improved coconut palms (WAT$^+$, RIT$^+$ and PYT $^+$) and three hybrids from the crossing of these improved coconuts (GPY$^+$ x GRL$^+$, GRL$^+$ x GOA$^+$ and GPY$^+$ x GOA$^+$). Results show that hybrids produce as many bunches per year as their parent, but they have more female flowers than the parent. Beyond Stem Height, Leaf Scar Number, Bunch number and Shell Weight, heterosis effects were observed. The highest values were observed with the number of female flowers (131.36%) and spikelets (31%), the Weight of Kernel (22.72%) and Copra (21.59%). Character heritabilities range from 0.02 to 0.97. The most heritable traits are the Number of Foliar Scars (h^2 = 0.97), Female Flowers (h^2 = 0.53), spikelet on the inflorescence (h^2 = 0.49) and Copra Weight (h^2 = 0.51). The high positive genetic correlations between morphological traits such as the C20, C150 and the number of female flowers, the number of spikelets and the copra weight that are more than 0.70 should allow an early selection of the coconuts potentially high producers.

Keywords: Improved Tall coconut, Improved hybrids, agromorphological traits, genetic links

Abbreviations

WAT$^+$ = Improved West African Tall
RIT$^+$ = Improved Rennell Island Tall
PYT $^+$ = Improved Polynesia Tall
C20 = Stem girth at 20 cm above soil level C150 = Stem girth at 150 cm above soil level

INTRODUCTION

The coconut (*Cocos nucifera* L.) is grown mainly for its fruits. The kernel of the fruit has a great economic and commercial interest and gives the coconut palm its industrial oleaginous plant quality (Bourdeix *et al*., 2005). From the dried kernel or copra, an oil called "coconut oil", available in some shops, is extracted. Copra is used in the manufacture of soap, margarine, cosmetics such as body oil. In Côte d'Ivoire, the creation of the hybrids coconut (Dwarf x Tall), has increased copra production from 0.6 to 4 t of copra / ha / year (De nucé *et al*., 1980, Konan, 2002). The hybrids scattering has led the national and world production increases. Despite the performance show by hybrids coconut Nain x Grand, some farmers prefer tall coconut because of the size of the nuts and their richness in oil and copra. Besides, the tall varieties, because of a highly developed vegetative system, have better withstand water deficits than Dwarves and Dwarf x Tall hybrids (Konan *et al*., 2006). In addition, Tall cultivars are grown because of their superior longevity and better yield relative to Dwarves cultivars.

To answer this concern, the tall coconut hybrids were created. These precocious hybrids are characterized by high growth, high production and require fewer inputs for their cultivation in peasant environments (De nucé *et al*., 1983). The second generation of Tall hybrids has been developed to improve the first one. This second generation of tall coconut hybrids was characterized by Konan *et al*. (2010). However, links between parents and descendants have never been discussed. This study focuses on agromorphological comparisons between parents and progeny and shows some genetic parameters. Its information could serve as a guide for breeders.

MATERIAL AND METHODS

Plant Material and Study Environment

The plant material consists of three hybrids of tall coconuts and their parents, which are three in number (Table 1). The hybrids were obtained according to the schema of figure 1, and put in experimentation in 1995 on the parcel 051 of the station Marc Delorme of the National Center of Agronomic Research (CNRA) in Côte d'Ivoire.

The geographical coordinates of the station are 5 ° 14 'and 5 ° 15' north latitude and 3 ° 54 'west longitude 3 ° 55'. The climate is of the equatorial type, characterized by 4 alternating seasons, including 2 rainy seasons and 2 dry seasons of unequal stretches. The average monthly temperatures vary from 24.62 ° C to 27.63 ° C. the sunshine is of the order of 2000h / year. The relative humidity is about 80 to 90%. The soil is of the tertiary type, consisting of coarse sand with organic matter content and rich in nutrients including 690 ppm of phosphorus (Tie bi 1984).

Table 1: Coconut hybrid and their parents in our study

Hybrid	**Parent Female**	**Male Parent**
PYT^+ x RIT^+	GPY^+ (Improved Polynesia Tall)	GRL^+ (Improved Rennell Island Tall)
RIT^+ x WAT^+	GRL^+ (Improved Rennell Island Tall)	GOA^+ (Improved West Africa Tall)
PYT^+ x WAT^+	GPY^+ (Improved Polynesia Tall)	GOA^+ (Improved West African Tall)

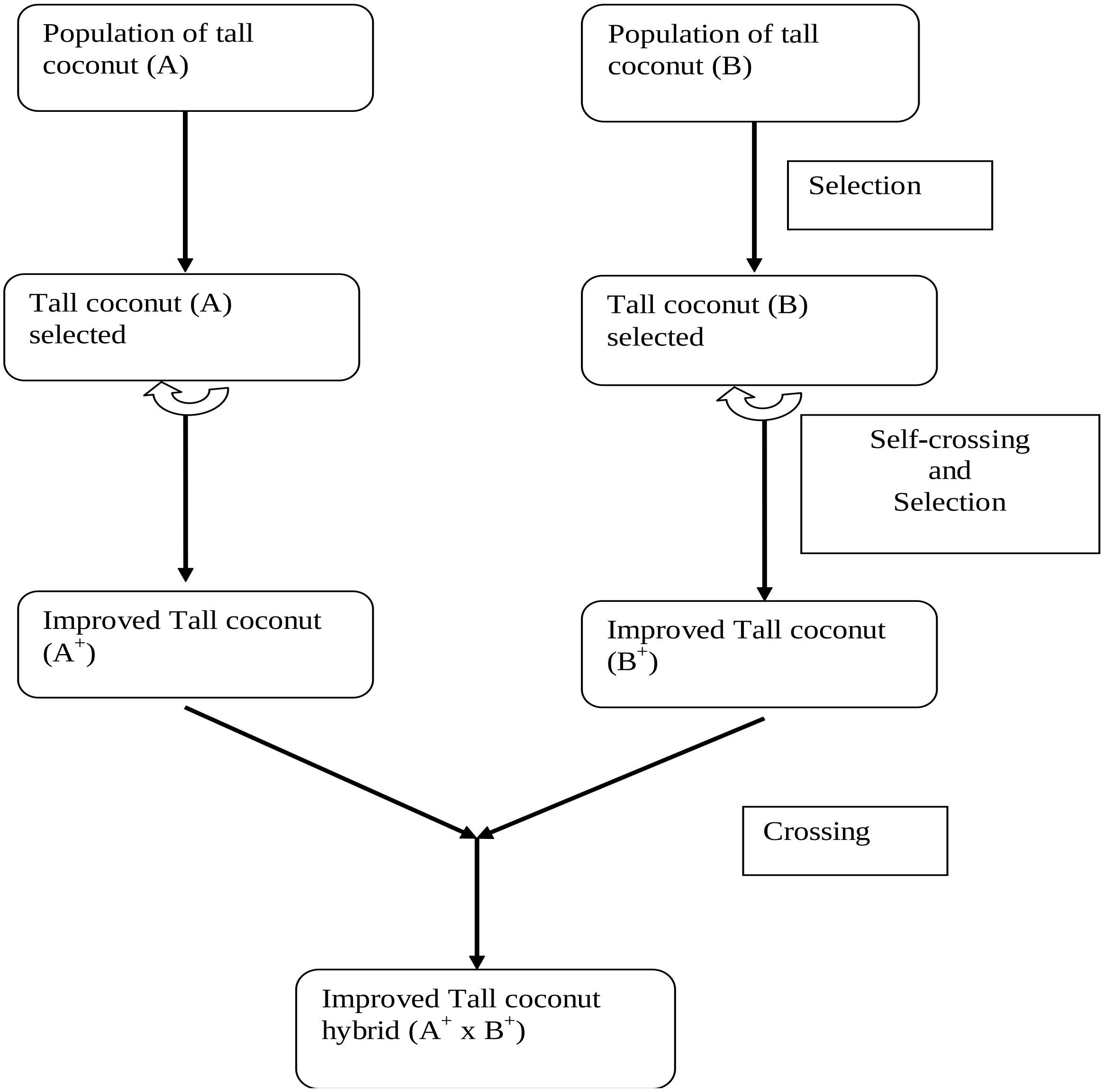

Figure 1: Simplified process of creating of improved tall coconut hybrids in Côte d'Ivoire

Methods

Ten trees were chosen per individual, for a total of 60 trees for all parents and progeny. Fourteen agromorphological descriptors from the coconut descriptors minimal list (Yao *et al*., 2015) were measured on all trees (Table 2).

Statistical Analysis

SPSS 22.0 software has been used to compare hybrids to their parents through the Dunnett test at 5% significance. VCE 6.0.2 software was used to estimate narrow sense heritabilities and genetic correlations. The heterosis effects were calculated in relation to the mean value of the parents according to the formula:

$$\text{Heterosis} = \frac{(Vh - VPm) \times 100}{VPm}$$

With Vh = Value of the hybrid, VPm = Value of the average parent.

RESULTS

Comparison of descendants–parents

Tables 2 to 5 present comparisons of the agromorphological characteristics of coconut hybrids to their parents. The stem strength of GPY+ x GRL+ is comparable to its parents. However it has less leaf scars, 12 against 19 and 17 for GPY+ and GRL+. GPY+ x GRL+ produces more spikelets (43) and female flowers (23) than her parents. He does not differ from his parents in bunch production by year. The weight of the nut of this hybrid (1072 g) is intermediate to that of both parents (800 and 1200 g).

He produces the same amount of husk and shell as his two parents. The weight of kernel and copra of this hybrid are superior to those of its female parent and statistically identical to those of the male parent.

GRL+ x GOA+ has more developed stem than its parents. However, it has less leaf scar (10) than the latter (17 and 13). This hybrid produces more spikelets (40) and female flowers (30) than its parents, but produces statistically the same amount of bunch per year. With the exception of the amount of copra produced by this hybrid (240 g) which is greater than that of its parents (189 g and 186 g), the other components of the nut have intermediate values to those of the latter. GPY+ x GOA+ has the more developed bulb than its GOA+ male parent and is comparable to its female GPY+ parent for this trait. The trunk of this hybrid is more robust (C150 = 93 cm) than that of both parents (C150 = 85 cm), but has fewer leaf scars than the latter. The bunch production per year of the hybrid is identical to that of the parents. The production of spikelet and female flowers of this hybrid is superior to those of her parents. He produces statistically the same weight of nuts and copra as his parents.

Table 2: list of descriptors measured in our study

Descriptors		Definition	Methods
1-	C20	Stem girth at 20 cm above soil level	The circumference of the stem measured at 20 cm from the ground is that of the bulb.
2-	C150	Stem girth at 1.5 m above soil level	The circumference of the stem is measured at 150 cm from the ground.
3-	HS	Stem height	The height of the stem is measured from the ground to the first leaf on the stem.
4-	NBCF	Number of leaf scars	The number of leaf scars is counted on the stem between 1 and 2 m of soil
5-	NBE	Number of spikelets	Number of spikelets The number of spikelets is determined by counting all the spikelets on the inflorescence of rank 14 (About 3 months of age).
6-	NBFF	Number of Female Flowers	The number of female flowers is counted on an inflorescence of rank 10 or newly opened.
7-	NBR	Number of bunch	Number of bunch collected per year
8-	MNE	Fruit weight	This is the average mass of 4 nuts per tree
9-	MND	Weight of fruit without husk	the average mass of 4 coconuts without husk per tree
10-	MB	Husk weight	It is the average mass of 4 cocnutshusks per tree
11-	MCQ	Shell weight	It is the average mass of 4 cocnuts shell per tree
12-	ME	Water weight	It is the average mass of 4 coconuts water per tree
13-	MALB	Kernel weight	It is the average mass of 4 coconuts kernel per tree
14-	MCP	Copra weight per nut	Mass of copra is obtained with the following formula: MALB x% MS / 0.94.

Table 3: Comparison of GPY+ x GRL+ to his parents

Descriptors	GPY+ x GRL+ Value	Genitors	Genitors Value	signification
C20 (cm)	165.09 ± 22.98	GPY+	152.30 ± 24.36	0.523
		GRL+	158.75 ± 37.77	0.844
C150 (cm)	87.42 ± 11.64	GPY+	85.39 ± 6.31	0.804
		GRL+	80.33 ± 5.12	0.113
HS (cm)	703.10 ± 69.04	GPY+	972.70 ± 52.91	<0.001
		GRL+	845.20 ± 89.93	<0.001
NBCF	12 ± 1.93	GPY+	19.50 ± 3.1	<0.001
		GRL+	17.60 ± 1.95	<0.001
NBE (g)	43.40 ± 6.06	GPY+	33.90 ± 5.93	0.003
		GRL+	28.50 ± 6.13	<0.001
NBFF	20.90 ± 5.32	GPY+	10.20 ± 6.39	<0.001
		GRL+	7.70 ± 2.50	<0.001
NBR	15.20 ± 1.69	GPY+	15.60 ± 1.65	0.857
		GRL+	16.10 ± 2.38	0.485
MNE (g)	1072.08 ± 205.46	GPY+	802 ± 72.15	0.003
		GRL+	1200.83 ± 208.14	0.189
MND (g)	714.58 ± 143.24	GPY+	496.66 ± 53.17	0.001
		GRL+	818.33 ± 147.53	0.123
MB (g)	357.48 ± 104.90	GPY+	304.99 ± 39.32	0.176
		GRL+	354.58 ± 42.28	0.994
MCQ (g)	170.35 ± 35.39	GPY+	330 ± 300	0.255
		GRL+	173.75 ± 31.61	0.999
ME (g)	168.33 ± 56.25	GPY+	89.99 ± 27.44	0.022
		GRL+	300 ± 93.17	<0.001
MALB (g)	392.92 ± 72.04	GPY+	276.66 ± 21.08	0.003
		GRL+	380 ± 105. 92	0.898
MCP (g)	213.47 ± 62.75	GPY+	157.90 ± 23.43	0.031
		GRL+	189.63 ± 51.59	0.454

C20: Stem girth at 20 cm above soil level; C150: Stem girth at 1.5 m above soil level; HS: Stem height; NBCF: Number of Foliar Scars; NBE: Number of leaf scars; NBR: Number of bunches; NBFF: Number of female flowers; MNE: Fruit weight; MND: Weight of fruit without husk; MB: Husk Weight; MCQ: Shell weight; MALB: Kernel Weight; ME: Water Weight; MCP: Copra Weight.

Table 4: Comparison of GRL^+ x GOA^+ to his parents

Descriptors	GRL^+ x GOA^+ Value	Genitors	Genitor value	Signification
C20 (cm)	194.98 ± 19.85	GRL^+	158.75 ± 37.77	0.013
		GOA^+	141.55 ± 22.31	<0.001
C150 (cm)	105.61 ± 8.81	GRL^+	80.33 ± 5.12	<0.001
		GOA^+	85.14 ± 5.37	<0.001
HS (cm)	872.80 ± 39	GRL^+	845.20 ± 89.93	0.651
		GOA^+	880.10 ± 93.74	0.969
NBCF	10 ± 0.74	GRL^+	17.60 ± 1.96	<0.001
		GOA^+	13 ± 1.49	<0.001
NBE	42.20 ± 5.43	GRL^+	28.50 ± 6.13	<0.001
		GOA^+	34.50 ± 7.04	0.019
NBFF	30.40 ± 8.44	GRL^+	7.70 ± 2.50	<0.001
		GOA^+	13.10 ± 6.19	<0.001
NBR	16.40 ± 1.58	GRL^+	16.10 ± 2.38	0.941
		GOA^+	15.60 ± 2.84	0.663
MNE (g)	1148.75 ± 157.72	GRL^+	1200.83 ± 208.14	0.698
		GOA^+	917.50 ± 103.52	0.007
MND (g)	743.75 ± 113.54	GRL^+	818.33 ± 147.53	0.268
		GOA^+	545.38 ± 71.06	0.001
MB (g)	405 ± 62.69	GRL^+	354.58 ± 42.28	0.050
		GOA^+	372.28 ± 36.02	0.241
MCQ (g)	161.25 ± 21.61	GRL^+	173.75 ± 31.61	0.396
		GOA^+	149.58 ± 13.53	0.442
ME (g)	166.25 ± 67.20	GRL^+	300 ± 93.17	<0.001
		GOA^+	101.25 ± 36.11	0.083
MALB (g)	426.25 ± 45.66	GRL^+	380 ± 105.92	0.422
		GOA^+	304.58 ± 41.13	0.003
MCP (g)	240.35 ± 38.91	GRL^+	189.63 ± 51.59	0.016
		GOA^+	186.47 ± 25.12	0.011

C20: Stem girth at 20 cm above soil level; C150: Stem girth at 1.5 m above soil level; HS: Stem height; NBCF: Number of Foliar Scars; NBE: Number of leaf scars; NBR: Number of bunches; NBFF: Number of female flowers; MNE: Fruit weight; MND: Weight of fruit without husk; MB: Husk Weight; MCQ: Shell weight; MALB: Kernel Weight; ME: Water Weight; MCP: Copra Weight.

Table 5: Comparison of GPY^+ x GOA^+ to his parents

Variables	GPY^+ x GOA^+ Value	Genitors	Genitors values	Signification
C20 (cm)	171.03 ± 18.37	GPY^+	152.30 ± 24.36	0.116
		GOA^+	141.55 ± 22.31	0.010
C150(cm)	93.47 ± 4.59	GPY^+	85.39 ± 6.31	0.005
		GOA^+	85.14 ± 5.37	0.004
HS (cm)	766.40 ± 52.37	GPY^+	972.70 ± 52.91	<0.001
		GOA^+	880.10 ± 93.74	0.002
NBCF	10 ± 1.45	GPY^+	19.50 ± 3.1	<0.001
		GOA^+	13 ± 1.49	0.006
NBE	41.10 ± 3.63	GPY^+	33.90 ± 5.93	0.017
		GOA^+	34.50 ± 7.04	0.029
NBFF	19.60 ± 1.35	GPY^+	10.20 ± 6.39	0.001
		GOA^+	13.10 ± 6.19	0.018
NBR	14.80 ± 1.55	GPY^+	15.60 ± 1.65	0.606
		GOA^+	15.60 ± 2.84	0.606
MNE (g)	956.25 ± 244.54	GPY^+	802 ± 72.15	0.070
		GOA^+	917.50 ± 103.52	0.809
MND (g)	638.75 ± 199.52	GPY^+	496.66 ± 53.17	0.033
		GOA^+	545.38 ± 71.06	0.189
MB (g)	319 ± 68	GPY^+	304.99 ± 39.32	0.757
		GOA^+	372.28 ± 36.02	0.044
MCQ (g)	132.50 ± 31.84	GPY^+	330 ± 300	0.136
		GOA^+	149.58 ± 13.53	0.982
ME (g)	141.25 ± 79.51	GPY^+	89.99 ± 27.44	0.071
		GOA^+	101.25 ± 36.11	0.177
MALB (g)	368.75 ± 96.33	GPY^+	276.66 ± 21.08	0.005
		GOA^+	304.58 ± 41.13	0.051
MCP (g)	196.46 ± 66.13	GPY^+	157.90 ± 23.43	0.099
		GOA^+	186.47 ± 25.12	0.825

C20: Stem girth at 20 cm above soil level; C150: Stem girth at 1.5 m above soil level; HS: Stem height; NBCF: Number of Foliar Scars; NBE: Number of leaf scars; NBR: Number of bunches; NBFF: Number of female flowers; MNE: Fruit weight; MND: Weight of fruit without husk; MB: Husk Weight; MCQ: Shell weight; MALB: Kernel Weight; ME: Water Weight; MCP: Copra Weight.

Genetic parameters

Heterosis effects in relation to the average value of the parents has been observed for all characters excepted HS, NBCF, NBR and MCQ (Table 6). The highest values of heterosis where observed with the yield characters such as the number of female flowers (131.36%), the number of spikelets (31%), the kernel weight (22.72%) and the weight of copra per nut (21.59%). Character heritabilities range from 0.02 to 0.97. Concerning the morphology, the most heritable character is the number of leaf scars (h2 = 0.97). The yield characters most heritable are the number of female flowers (h2 = 0.53), the copra weight per nut (h2 = 0.51) and the number of spikelets (h2 = 0.49).

Several genetic correlations were observed between the measured characters (Table 7).Correlations above or equal to 0.70 were analyze. The circumference of the stem at 20 cm from the soil is positively related to that at 150 cm of soil (r = 0.71) and the mass of copra per coconut (r = 0.91). The circumference of the stem at 150 cm from the soil is correlated with the number of spikelets (r = 0.82) and the number of female flowers (r = 0.96).

The number of leaf scars and the height of the stem are correlated (r = 0.97). The number of spikelets on the inflorescence and the number of female flowers evolved in the same direction (r = 0.93). The weight of the fruit depends of the husk weight (r = 0.76) and the coconut water (r = 0.72). The weight of copra per coconut is linked to that of the albumen (r = 0.82).

Table 6: Heterosi effects and heritability of traits

Variables	GPY⁺ x GRL⁺	GRL⁺ x GOA⁺	GPY⁺ x GOA⁺	Average Heterosis (%)	Heritability
C20 (cm)	6.15	29.85	16.40	17.47 ± 11.89	0.14 ± 0.06
C150 (cm)	5.50	27.65	9.62	14.25 ± 11.78	0.10 ± 0.04
HS (cm)	-22.65	1.18	-17.27	-12.91 ± 12.50	0.13 ± 0.08
NBCF	-34.23	-35.29	-39.08	-36.20 ± 02.55	0.97 ± 0.01
NBE	39.10	33.97	20.18	31.08 ± 09.79	0.49 ± 0.10
NBFF	133.52	192.31	68.24	131.36 ± 62.06	0.53 ± 0.13
NBR	-4.10	3.47	-5.13	-1.92 ± 04.70	0.02 ± 0.02
MNE (g)	7.06	8.46	11.22	8.91 ± 02.12	0.08 ± 0.06
MND (g)	8.68	9.08	22.60	13.45 ± 07.92	0.02 ± 0.02
MB (g)	8.40	11.44	-5.80	4.68 ± 09.20	0.14 ± 0.09
MCQ (g)	-32.37	-0.26	-44.74	-25.79 ± 22.96	0.24 ± 0.12
ME (g)	-13.68	-17.13	47.71	5.63 ± 36.48	0.13 ± 0.10
MALB (g)	19.67	21.61	26.88	22.72 ± 03.73	0.12 ± 0.06
MCP (g)	22.85	27.81	14.10	21.59 ± 06.94	0.51 ± 0.12

C20: Stem girth at 20 cm above soil level; C150: Stem girth at 1.5 m above soil level; HS: Stem height; NBCF: Number of Foliar Scars; NBE: Number of leaf scars; NBR: Number of bunches; NBFF: Number of female flowers; MNE: Fruit weight; MND: Weight of fruit without husk; MB: Husk Weight; MCQ: Shell weight; MALB: Kernel Weight; ME: Water Weight; MCP: Copra Weight.

Table 7: Genetic correlations between measured traits

	C20	C150	HS	NBCF	NBE	NBFF	NBR	MNE	MND	MB	MCQ	ME	MALB	MCP
C20	1	**0.71**	-0.79	-0.85	0.13	0.46	0.17	-0.17	0.24	-0.46	-0.04	0.44	0.53	**0.91**
C150		1	-0.24	-0.43	**0.82**	**0.96**	-0.60	-0.53	-0.34	-0.77	-0.29	0.09	-0.12	0.45
HS			1	**0.97**	0.29	0.00	-0.41	0.27	-0.15	-0.17	-0.34	-0.05	-0.89	-0.95
NBCF				1	0.07	-0.23	-0.22	0.44	-0.05	-0.01	-0.17	-0.01	-0.83	-0.98
NBE					1	**0.93**	-0.93	-0.58	-0.62	-0.69	-0.39	-0.21	-0.57	-0.10
NBFF						1	-0.75	-0.60	-0.44	-0.79	-0.46	-0.03	-0.29	0.24
NBR							1	0.66	**0.84**	0.38	0.19	0.53	0.63	0.31
MNE								1	**0.76**	-0.01	0.06	**0.72**	-0.16	-0.31
MND									1	-0.12	-0.29	**0.85**	0.35	0.22
MB										1	0.64	-0.56	0.40	-0.12
MCQ											1	-0.35	0.20	0.05
ME												1	0.03	0.21
MALB													1	**0.82**
MCP														1

NB: bold values are positive genetic correlations above or equal to 0.70 C20: Stem girth at 20 cm above soil level; C150: Stem girth at 1.5 m above soil level; HS: Stem height; NBCF: Number of Foliar Scars; NBE: Number of leaf scars; NBR: Number of bunches; NBFF: Number of female flowers; MNE: Fruit weight; MND: Weight of fruit without husk; MB: Husk Weight; MCQ: Shell weight; MALB: Kernel Weight; ME: Water Weight; MCP: Copra Weight.

DISCUSSION

The comparison of the hybrids with the parents is important to have an idea of the improvement of the characters. Others works comparing hybrids of coconut Dwarf x Tall to their genitors have been conducted by other authors (Koffi *et al*., 2014).

The stem of coconut hybrids is more robust than that of their parents. That could allow them to be more wind resistant and retain more water during the dry season to improve their production (Konan *et al*., 2006). However, these hybrids have less leaf scars on their stem. The number of leaf scars on the stem is indicative of leaf emanation rate and therefore the number of bunches because in the axil of each leaf is usually a bunch (Bourdeix *et al*., 2005). Hybrid resulting from Tall coconut improved are expected to produce fewer bunches per year than their parents. However the results show that genitors and progeny have statistically the same bunch production. The robustness of the hybrids stems would have facilitated the mobilization of nutrients needed for bunch production as well as the number of female spikelets and flowers on the inflorescence.

The values of the nut weight and that of its components of the hybrids are intermediate to those of the female and male parents with the exception of the weight of the shell which is inferior or equal to those of the parents. Positive heterosis effects for these different components with the exception to the weight of shell support this finding.

Concerning the nut, the highest heterosis effects where observed with the weight of the kernel and the weight of copra per nut. As copra is the most traded coconut product,this improvement work should be of economic interest for nuciculture. Otherwise, the high positive correlation between the weight of the kernel and the weight of the copra should facilitate the improvement of the copra through those of the kernel which is easily measurable, however the heritability of character is very weak. In contrast, the mass of coconut per nut has a relatively high heritability. The work of Meunier *et al*. (1984) on unimproved hybrids coconut also showed strong heritability of copra per nut. These authors have shown that the heritability of character is higher when the cross is made between tall coconut than when it is a dwarf coconut and Tall coconut crossing. Moreover, the work of Koffi (2016) showed a medium heritability of this character.

Because of its high heritability, the character of the copra per nut could be easily improved by simple selection by exerting a strong selection pressure on the genitors. The improvement of other less heritable characters could be done on the basis of the selection of the descendants.

The most heritable characters have low heterosis effect, and these two parameters would evolve in opposite directions, as can be seen from the number of leaf scars. Genetic correlations could be the consequence of the effects of additivity, dominance and gene interaction between them. These different links between the variables can be explained by the phenomena of linkage or pleiotropy (Le Cohec and Soreau, 1992). The high correlation between the number of female flowers and the number of spikelets shows that each spikelet has a female flower. Improving the number of spikelets could therefore improve the number of female flowers carried by the inflorescence and consequently the number of nuts per bunch. Positive genetic correlations between morphological variables and yield variables should attract more attention. Indeed morphological characters such as C20 and C150, can be measured before the production of trees. Positive and high relationships between these traits and number of female flowers, number of spikelets, and amount of copra per nut could allow early selection of potentially high producing individuals.

CONCLUSION

This study reports on the comparison of agromorphological characteristics between genitors and progeny and the study of genetic links. The plant material consists of three improved coconuts (GOA^+, GRL^+ and GPY^+) and three hybrids from the crossing of these improved coconuts. This is GPY^+ x GRL^+, GRL^+ x GOA^+ and GPY^+ x GOA^+. It appears from this work that hybrids produce as many bunches per year as their parent but have more female flowers on the inflorescence than the latter. Except of stem height, leaf scar number, bunch number and husk mass, heterosis effects were observed relative to the mean parent value. The highest values were observed with the number of female flowers (131.36%), the number of spikelets (31%), the kernel weight (22.72%) and, the weight of copra per nut (21.59%). The most heritable traits are the Number of Foliar Scars (h2 = 0.97), the Number of Female Flowers (h2 = 0.53), the weight of copra per nut (h2 = 0.51) and the number of spikelet on the inflorescence (h2 = 0.49).

High positive genetic correlations between morphological traits such as stem circumference at 20 and 150 cm from the soil and number of female flowers, spikelet number and amount of copra per nut should allow early selection of the coconuts potentially high producers.

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