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Variability and Correlation Studies for Vegetative, Floral, Nut and Yield Characters in Indigenous and Exotic Coconut Genotypes

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A B S T R A C T

Genetic variability and correlation analysis of vegetative, floral, nut and yield characters were studied with 11 tall and 3 dwarfs which include 6 indigenous and 8 exotic coconut genotypes from diverse geographic origin. Analysis revealed a high degree of variability for most of the character studied. The variability studies among fourteen genotypes for different traits revealed that number of nuts per palm, dehusked nut weight, whole nut weight, plant height, stem girth, petiole length, shell thickness, number of female flowers and number of nuts per bunch recorded high values for phenotypic coefficient of variation and genotypic coefficient of variation. Heritability estimates for all the characters studied were grouped as high. Genetic advance expressed on per cent mean was high for whole nut weight, dehusked nut weight, petiole length, number of nuts per bunch, number of female flowers per palm, number of nuts per palm. Correlation studies with nut yield per palm showed a positive and significant association with number of female flowers /palm/year, number of nuts/bunch, whole nut weight, husk thickness, kernel thickness, shell thickness, husk weight, copra content. Oil content exhibited positive and significant association with kernel weight and copra weight. This genetic analysis indicates the use of these characters in selection for coconut improvement. Thus, these characters are to be given importance for nut yield improvement in coconut.

Introduction

The coconut *Cocos nucifera* L. is grown throughout the tropics as a plantation crop yielding several agronomic products that are important to export economies in these regions (Harries, 1995). This palm, a monotypic species of the family arecaceae is a cross-pollinated crop with wide variability for most of the morphological traits. Variability always provides more possibility of selecting desired types (Vavilov, 1951). The study of variability in genetic stocks of coconut palm is a pre-requisite for any breeding programme. Since yield is the most important criterion for selection, an estimate of inter-relationship of yield with other characters is of immense help in crop improvement programme. Assessment

of the nature and extent of variability among the genotypes will be of immense value in identifying superior genotypes and formulating breeding procedures. The analysis of genetic variation or diversity in coconut has been assessed for many years using morphological traits (Meunier *et al*., 1992). Selection of characters could be done only if there is genetic variation. The variability available in the population could be partitioned in to heritable and non heritable components, using genetic parameters, phenotypic and genotypic coefficients of variation, heritability and genetic advance based on which selection can be effectively carried out. For achieving a reasonable improvement in yield, an understanding of correlation between characters would be very useful (Natarajan *et al*.2010). Earlier, Patel (1937), Satyabalan and Mathew (1984) and Ganesamoorthy *et.al*. (2002) had worked out correlation between characters.

Hence the present study was undertaken to genetically analyze the extent of variability, association of vegetative, floral, yield components and nut characters on yield in 8 indigenous and 6 exotic coconut genotypes.

Materials and Methods

The study was conducted at Coconut nursery, Department of Spices and Plantation crops, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore during the year 2013-2014. Genotypes studied and their origins are furnished below.

Field plot technique to assess the performance of adult palm

All the indigenous and exotic genotypes were planted at a distance of 7.5 x 7.5 m. These genotypes were of 19 years old at the time of experiment. The experiment was laid out in a randomized block design with 2 replications with each genotype representing six palms per replication. Observations were recorded from all the six palms representing each genotype in each replication on vegetative, floral, nut and yield characters and the mean values were arrived at.

Vegetative characters

The height of the palm was measured from the collar region to the base of crown region and expressed in meters. The girth of the stem at one meter above collar region was measured and expressed in centimeters. The number of leaves per palm during each harvest were counted and recorded. Petiole length was measured for three leaves per palm and mean length of the petiole was arrived and expressed in metre. The numbers of leaflets on both sides of same three leaves were counted and the mean values are calculated. Length of the leaf was measured for three leaves per palm and mean length of the leaf was arrived and expressed in metre.

Floral characters

The number of inflorescence produced per month was counted and the sum of inflorescences produced per year was arrived at. The length of spadix was measured from the base of the stalk to the inflorescence tip and the mean values were expressed in centimetre. The length of the stalk was measured from the base of the stalk to its tip and the mean values were expressed in centimetre. The number of female flowers present per inflorescence was counted and the mean values were recorded.

Nut and yield characters

For whole nut weight, harvested nuts of 5 per genotype were weighed and recorded and their mean values were expressed in grams whereas

for dried nuts they were dehusked and mean weight was expressed in grams. Husk weight was recorded for five nuts and their mean values were expressed in grams. Husk thickness at the widest portion for the same five nuts was measured and the mean values were arrived at centimeter. The kernel weight was recorded for 5 nuts and the mean values were expressed in grams. The shell of five nuts was weighed and the mean values were expressed in grams for shell weight. Dehusked nuts were deshelled and the kernel (endosperm) was split into two halves to measure endosperm/kernel thickness and the mean values were expressed in centimeter. The shell thickness was measured at the middle region of the nut and the mean values were expressed in centimeter. The number of nuts per bunch per harvest was counted and total number of nuts/bunch was arrived at. Number of nuts per palm in each harvest recorded and total number of nuts per palm per year arrived at. The length of the nut from one pole to other was measured by setsquare blocking of the nut and measuring the distance using a meter scale gave the polar diameter of the fruit in centimeter. The breadth of the nut at the middle portion measured by setsquare blocking of the nut and measuring the distance using a meter scale gave the equatorial diameter of the nut in centimeter. The copra content was recorded by, dehusked nuts were deshelled and dried under the sun to remove the moisture for a week and the mean values were expresses in g. Oil content in percentage was measured by extraction procedure carried out in soxhlet extractor as per AOAC (1970).

Statistical analysis

The mean values of morphological, floral, nut and yield characters over 12 months on the 14 genotypes were subjected to statistical analysis. Variability and correlation studies for all the above characters were studied using TNAUSTAT (https://sites.google.com/site/tnaustat)

Results and Discussion

Variability, heritability and genetic advance in adult palm

Variation studies provide basic information regarding the genetic properties of the population, based on which, breeding methods are formulated for further improvement of the crop. The results observed from variability studies revealed that estimates of phenotypic variance and phenotypic coefficient of variation were higher in magnitude than genotypic variance and genotypic coefficient of variation, indicating that the apparent variation is not only due to genotype but also due to the influence of environment.

The magnitude of variation as represented by genotypic variance, phenotypic variance, phenotypic coefficient of variation and genotypic coefficient of variation are presented in Table 2. It was observed that phenotypic and genotypic variances were high for whole nut weight, dehusked nut weight, husk weight, number of female flowers per palm and its value was low for number of leaves and petiole length. The presence of high genotypic and phenotypic variances for the above characters indicated that these characters were more viable than the other characters studied among the coconut genotypes. Hence selections for these characters will be efficient. This was in accordance with the results obtained by Balakrishnan *et al.*, (1991) and Renuga (1999) and Augustine Jerard (2002).

In the present study, number of nuts per palm, dehusked nut weight, whole nut weight, plant height, stem girth, petiole length, shell thickness, number of female flowers and number of nuts per bunch recorded high values for phenotypic coefficient of variation

and genotypic coefficient of variation (Table 2), and as such there is enough scope for improvement of these traits through selection. The existence of such high extent of genetic variation for various characters were observed earlier and reported by Louis (1981) for number of nuts per palm and number of female flowers, Muluk (1987) for plant height and Patil *et al.,* (1993b) for dehusked nut weight, number of nuts per palm and Selvaraju and Jayalekshmi (2011). Low values for phenotypic coefficient of variation and genotypic coefficient of variation were observed for spadix length, kernel thickness and oil content, suggesting that these characters were less stable and highly susceptible for random environmental effects. This is in consonance with the findings of Patil *et al.,* (1993b) Renuga (1999) and Augustine Jerard (2002). It was observed that the genotypic coefficient of variation varied with the characters and this brought out the presence of genetic diversity for different traits.

Heritability estimates are useful in selecting genotypes based on phenotypic performance. The heritable variation may be effectively used with greater accuracy when studied in conjunction with genetic advance (Burton, 1952; Swarup and Chaugale, 1962). Johnson *et al.*, (1955) suggested that heritability and genetic advance when considered together were more useful for predicting the resultant effect of selecting the best individuals than heritability or genetic advance considered alone. It was also stated that genetic gain along with high heritability proves effective in the selection programme.

Table.1 Genotypes and their origin

Sl. No.	Genotype	Origin
1.	Jamaica Tall	Jamaica
2.	Zanzibar	Zanzibar
3.	British Solomon Island	Solomon Islands
4.	Fiji tall	Fiji islands
5.	Philippines Ordinary	Philippines
6.	Straight Settlement Green	Malaysia
7.	Andaman Ordinary	India
8.	Laccadive Micro	India
9.	Laccadive Ordinary	India
10.	West coast Tall	India
11.	East coast Tall	India
12.	Malayan Yellow Dwarf	Malaysia
13.	Malayan Green Dwarf	Malaysia
14.	Chowghat Orange Dwarf	India

Table.2GCV, PCV, heritability and genetic advance as percent mean for vegetative, floral, nut and yield characters in coconut genotypes

Characters	Genotypic variance	Phenotypic variance	GCV	PCV	Heritability (%)	Genetic advance as Per cent of mean (%)
Plant height	7.92	9.08	27.9	29.89	87.23	53.71
Stem girth	141.1	195.19	12.4	14.61	72.28	21.76
No of bunches	0.54	0.87	7.04	8.94	62.12	11.44
No of nuts /bunch	1.55	1.88	16.2	17.86	82.51	30.35
No of leaves	4.72	6.81	6.87	8.25	69.29	11.78
Leaf length	633.3	821.8	5.63	6.41	77.07	10.18
Leaf breadth	208.5	261.6	6.83	7.65	79.71	12.56
Leaf petiole length	66.3	71.73	7.19	7.49	92.49	14.26
Leaflet breadth	0.24	0.39	10.2	13.10	60.80	16.41
Leaflet on one side	29.7	31.06	4.81	4.91	95.70	9.68
Spadix length	117.8	188.2	9.70	12.26	62.57	15.81
Stalk length	9.25	12.4	6.74	7.81	74.34	11.97
No of inflorescence/palm	0.56	0.64	6.31	6.74	87.41	12.14
No of female flowers /palm	327.4	632.53	16.7	23.21	51.77	24.75
Whole nut weight	14126.4	16918.3	17.6	19.26	83.50	33.12
Dehusked nut weight	4039.2	5971.10	16.9	20.60	67.65	28.71
Husk weight	6431.7	7222.42	25.3	26.85	89.05	49.25
Husk thickness	0.050	0.058	10.8	11.63	86.27	20.66
Kernel weight	868.6	1172.2	15.8	18.40	74.11	28.09
Kernel thickness	0.009	0.01	8.11	8.32	94.93	16.27
Shell weight	147.9	204.4	15.51	18.23	72.36	27.18

*GCV- Genotypic coefficient of variation, *PCV-Phenotypic coefficient of variation

Table.3 Genotypic correlation coefficient for vegetative, floral and nut character of coconut genotypes

Characters	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	Y
X1	1.000	0.433	0.413	0.144	0.669**	0.261	0.778**	-0.087	0.863**	0.546 *	0.636**	0.536*	0.590*	0.176
X2		1.000	-0.584*	0.266	-0.584*	0.470*	0.679**	-0.269	0.734**	0.358	0.720**	0.689**	0.686**	-0.909**
X3			1.000	0.469*	0.887**	-0.311	0.809**	0.824**	0.982**	0.493*	0.457	0.373	0.665**	0.766**
X4				1.000	0.033	-0.302	0.180	-0.460*	-0.024	-0.262	0.176	-0.012	0.573*	0.896**
X5					1.000	0.562*	0.832**	0.671**	1.070**	0.807**	0.714**	0.502*	0.700**	0.461*
X6						1.000	0.611*	0.741**	0.510**	0.559*	0.721**	0.470*	0.064	-0.342
X7							1.000	0.218	1.071**	0.715**	0.831**	0.694**	0.539*	-0.097
X8								1.000	0.174	0.184	0.768**	0.283	0.399	0.535*
X9									1.000	0.612*	0.851**	0.745**	0.696**	0.090
X10										1.000	0.558*	0.415	0.453	-0.246
X11											1.000	0.789**	0.317	-0.220
X12												1.000	0.325	-0.100
X13													1.000	0.465*
Y														1.000

*Significant at 5 per cent level **Significant at 1 per cent level

X1 - Plant height, X2 - Stem girth,X3 - No of bunches, X4 - No of nuts per bunch per palm, X5- No of leaves per palm, X6- Leaf length, X7- Leaf breadth,X8- Leaf petiole length, X9- Leaflet breadth, X10- Leaflet on one side, X11- Spadix length, X12- Stalk length, X13-No of inflorescence per palm per year, Y- No of nuts per palm per year (yield)

Table.4 Genotypic correlation coefficient for vegetative, floral and nut character of coconut genotypes

Character	X14	X15	X16	X17	X18	X19	X20	X21	X22	X23	X24	X25	X26	Y
X1	-0.568*	0.523*	0.262	0.705**	0.833**	0.816**	0.185	0.188	0.782**	0.890**	0.549*	0.293	0.027	0.176
X2	0.330	0.196	0.138	0.462*	0.544*	-0.192	0.711**	-0.197	0.569*	0.218	-0.028	0.177	0.056	-0.909**
X3	0.637**	0.429	0.400	0.727**	0.842**	0.348	0.376	0.623**	0.758**	0.934**	0.558*	0.323	0.020	0.766**
X4	0.889**	0.221	0.548*	0.191	-0.098	0.169	0.555*	0.589*	0.886**	0.070	0.558*	0.049	0.524*	0.896**
X5	0.283	0.787**	0.618**	0.842**	0.902**	0.461*	0.909**	0.524*	1.013**	1.093**	0.603*	0.468*	0.311	0.461*
X6	0.008	0.463*	0.521*	0.388	0.502*	-0.453	0.543*	0.475*	0.614**	0.377	0.209	0.398	0.514*	-0.362
X7	0.016	0.698**	0.430	0.843**	0.922**	0.344	0.964**	0.328	1.013**	0.787**	0.483*	0.411	0.148	-0.097
X8	-0.093	0.223	0.342	0.163	0.216	0.251	0.301	0.271	0.409	0.144	-0.097	0.261	0.317	0.553*
X9	0.424	0.817**	0.553*	0.883**	0.970**	0.510*	1.036**	0.523*	0.943**	0.711**	0.779**	0.380	0.269	0.090
X10	0.454	0.659**	0.416	0.654**	0.456	-0.435	0.710**	0.535*	0.429	0.761**	0.344	0.450	0.475*	-0.246
X11	0.328	0.560*	0.509	0.627**	0.708**	0.423	0.765**	0.529*	0.826**	0.571*	0.414	0.424	0.362	0.220
X12	-0.440	0.647**	-0.456	0.744**	-0.326	-0.373	0.330	0.402	0.400	0.582*	-0.497	0.437	0.163	-0.100
X13	0.612*	0.498*	0.389	0.570*	0.626**	0.466*	0.691**	0.439	0.532*	0.594*	0.419	0.379	0.235	0.465*
X14	1.000	0.083	0.647**	0.193	0.174	0.477*	0.248	0.683*	0.773**	0.248	0.883**	-0.039	0.666**	0.823**
X15		1.000	0.912**	0.927**	0.859**	0.563*	0.688**	0.896**	0.763**	0.788**	0.841**	0.750**	0.646**	0.272
X16			1.000	0.685**	0.605*	0.988**	0.550*	0.613*	0.597*	0.475*	0.606*	0.813**	0.913**	0.599*

X17				1.000	0.968**	0.607**	0.870**	0.647**	0.873**	0.881**	0.820**	0.563*	0.318	-0.167
X18					1.000	-0.425	0.956**	0.555*	-0.256	1.057**	0.677**	0.614**	0.468*	-0.067
X19						1.000	0.574*	0.422	0.436	0.417	0.561*	0.438	0.407	0.477*
X20							1.000	0.657**	0.946**	0.865**	0.544*	0.468*	0.137	0.085
X21								1.000	0.543*	0.430	0.582*	0.862**	0.913**	0.467*
X22									1.000	0.914**	0.577*	0.407	0.550*	0.903**
X23										1.000	0.665**	0.605*	0.144	0.219
X24											1.000	0.445	0.775*	0.827**
X25												1.000	0.685**	-0.110
X26													1.000	0.708**
Y														1.000

*Significant at 5 per cent level **Significant at 1 per cent level

X1 - Plant height, X2 - Stem girth,X3 - No of bunches, X4 - No of nuts per bunch per palm, X5- No of leaves per palm, X6- Leaf length, X7- Leaf breadth,X8- Leaf petiole length, X9- Leaflet breadth, X10- Leaflet on one side, X11- Spadix length, X12- Stalk length, X13-No of inflorescence per palm per year,X14 -No of female flowers per palm per year,X15-Whole nut weight, X16-Dehusked nut weight, X17-Husk weight, X18-Husk thickness, X19-Kernel weight, X20-Kernel thickness, X21- Shell weight, X22- Shell thickness, X23- Copra content, X24- Oil content, X25- Nut length, X26- Nut breadth,Y- No of nuts per palm per year (yield)

Table.5 Phenotypic correlation coefficient for vegetative, floral, nut and yield character of coconut genotypes

Characters	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	Y
X1	1.000	0.322	0.402	0.150	0.585*	0.188	0.690**	-0.078	0.600*	0.506*	0.433	0.484*	0.516*	0.110
X2		1.000	-0.532*	0.124	-0.555*	0.459*	0.436	0.188	0.347	0.270	0.527*	0.438	0.490*	-0.459*
X3			1.000	0.554*	0.739**	-0.299	0.577*	0.759**	0.667**	0.363	0.473*	0.377	0.454	0.289
X4				1.000	0.129	-0.314	-0.163	-0.495*	0.031	-0.231	-0.060	-0.033	0.461*	0.878**
X5					1.000	0.404	0.662**	0.538*	0.693**	0.640**	0.610*	0.410	0.515*	0.126
X6						1.000	0.495*	0.704**	0.421	0.468*	0.565*	0.466*	0.528*	-0.358
X7							1.000	0.244	0.737**	0.674**	0.433	0.516*	0.467*	-0.077
X8								1.000	0.204	0.178	0.581*	0.258	0.325	-0.504*
X9									1.000	0.495*	0.592*	0.420	0.547*	0.059
X10										1.000	0.483*	0.312	0.421	-0.212
X11											1.000	0.596*	0.158	0.125
X12												1.000	0.252	-0.036
X13													1.000	0.463*

*Significant at 5 per cent level **Significant at 1 per cent level

X1 - Plant height, X2 - Stem girth,X3 - No of bunches, X4 - No of nuts per bunch per palm, X5- No of leaves per palm, X6- Leaf length, X7- Leaf breadth,X8- Leaf petiole length, X9- Leaflet breadth, X10- Leaflet on one side, X11- Spadix length, X12- Stalk length, X13-No of inflorescence per palm per year, Y- No of nuts per palm per year (yield)

Table.6 Phenotypic correlation coefficient for vegetative, floral, nut and yield character of coconut genotypes

CHARACTER	X14	X15	X16	X17	X18	X19	X20	X21	X22	X23	X24	X25	X26	Y
X1	0.148	0.400	0.147	0.622**	0.739**	0.124	0.745**	0.129	0.646**	0.568*	0.485*	0.182	0.001	0.110
X2	-0.526*	0.173	0.119	0.290	0.377	0.127	0.579*	0.126	0.418	0.049	-0.037	0.155	0.020	-0.459*
X3	0.548*	0.412	0.338	0.611*	0.655**	0.336	0.418	0.524*	0.568*	0.422	0.515*	0.436	0.107	0.477*
X4	0.664**	0.154	0.606*	-0.133	-0.099	0.338	0.609*	0.586*	-0.163	0.152	0.510*	0.045	0.495*	0.878**
X5	0.211	0.627**	0.472*	0.719**	0.784**	0.397	0.815**	0.437	0.776**	0.658**	0.518*	0.360	0.271	0.126
X6	0.091	0.473*	0.580*	0.383	0.404	-0.346	0.458	0.453	0.528*	0.201	0.109	0.250	0.471*	-0.358
X7	0.032	0.541*	0.268	0.692**	0.769**	0.248	0.820**	0.261	0.740**	0.455	0.406	0.284	0.086	-0.077
X8	-0.102	0.203	0.282	0.170	0.185	0.204	0.267	0.212	0.344	0.123	-0.108	0.211	0.243	-0.504*
X9	0.291	0.669**	0.456	0.774**	0.718**	0.399	0.795**	0.407	0.735**	0.576*	0.592*	0.386	0.241	0.059
X10	0.297	0.316	0.358	0.624**	0.727**	-0.455	0.677**	0.407	0.431	0.573*	0.360	0.452	0.431	-0.212
X11	0.178	0.563*	0.448	0.565*	0.593*	0.453	0.697**	0.441	0.736**	0.473*	0.342	0.453	0.412	0.125
X12	-0.160	0.505*	0.319	0.622**	0.603*	-0.289	0.324	0.272	0.394	0.321	-0.330	0.252	0.093	-0.036
X13	0.302	0.361	0.228	0.520*	0.561*	0.264	0.593*	0.266	0.437	0.357	0.360	0.208	0.107	0.463*
X14	1.000	0.052	0.614**	0.099	0.106	0.484*	0.198	0.388	0.668*	0.123	0.742	-0.079	0.630*	0.528*
X15		1.000	0.879**	0.887**	0.799**	0.478*	0.671**	0.837**	0.763**	0.686**	0.781**	0.740**	0.637**	0.183
X16			1.000	0.638**	0.566*	0.971**	0.490*	0.666**	0.582*	0.593*	0.585*	0.806**	0.896**	0.475*

X17				1.000	0.934**	-0.374	0.837**	0.596*	0.854**	0.697**	0.777**	0.532*	0.324	-0.110
X18					1.000	-0.414	0.210	0.422	-0.402	0.743**	0.656**	0.551*	0.473*	-0.007
X19						1.000	0.498*	0.975**	0.487*	0.507*	0.550*	0.518	0.913**	-0.003
X20							1.000	0.401	0.407	0.653**	0.409	0.469*	0.495*	0.038
X21								1.000	0.504*	0.519*	0.589*	0.420	0.492*	-0.052
X22									1.000	0.721**	0.531*	0.409	0.459*	0.545*
X23										1.000	0.584*	0.652**	0.356	0.252
X24											1.000	0.454	0.709**	0.641**
X25												1.000	0.354	-0.056
X26													1.000	0.471*
Y														1.000

*Significant at 5 per cent level **Significant at 1 per cent level

X1 - Plant height, X2 - Stem girth,X3 - No of bunches, X4 - No of nuts per bunch per palm, X5- No of leaves per palm, X6- Leaf length, X7- Leaf breadth,X8- Leaf petiole length, X9- Leaflet breadth, X10- Leaflet on one side, X11- Spadix length, X12- Stalk length, X13-No of inflorescence per palm per year,X14 -No of female flowers per palm per year,X15-Whole nut weight, X16-Dehusked nut weight, X17-Husk weight, X18-Husk thickness, X19-Kernel weight, X20-Kernel thickness, X21- Shell weight, X22- Shell thickness, X23- Copra content, X24- Oil content, X25- Nut length, X26- Nut breadth, Y- No of nuts per palm per year (yield)

Heritability estimates for all the characters studied were grouped as high. Similarly high heritability estimates were reported for number of leaves per palm is in consonance with the findings of Liyanage (1960); for number of female flowers per palm by Nambiar and Nambiar (1970); number of bunches per palm, nuts per bunch and kernel weight and shell weight by Patil *et al*., (1993b); dehusked nut weight by Liyanage and Sakai (1960); and oil content by Menuier *et al.*, (1984). Selvaraju and Jayalekshmi (2011) reported high heritability for all the characters studied among 30 palms belonging to six coconut cultivar or varieties. They reported high heritability coupled with high genetic advance for whole nut weight, dehusked nut weight, number of nuts per palm per year. High heritability estimates for all the characters indicate high degree of inheritance of these characters in further generation.

Genetic advance is a measure of genetic gain that can be expected in the process of selection. Genetic advance expressed as per cent mean was high for whole nut weight, dehusked nut weight, petiole length, number of nuts per bunch, number of female flowers per palm, number of nuts per palm. Louis (1981), Balakrishnan *et al*., (1991), Renuga (1999) and Selvaraju and Jayalekshmi (2011) also reported high genetic advance for number of nuts per palm per year. Ganesamoorthy *et al.* (2002) had reported high genetic advance for copra yield, dehusked nut weight, nut yield and whole nut weight. This suggests that selection for all the characters chosen have good role in yield improvement in coconut.

Correlation studies

Growth is a complex entity associated with many characters, which are themselves interrelated. Such inter relationship of various growth components is highly essential to understand the relative importance of each character involved. If genetic correlation is high, attempts to obtain response in one character by selecting for the associated trait may be worth-while. This is especially true for the dependant character like nut yield. Knowledge of the association between yield and other biometrical traits themselves will greatly help in effecting selection for high yield. Genotypic and phenotypic correlations of different biometrical traits with nut yield per palm were estimated and presented in Table 3, 4, 5 and 6.

In general, genotypic correlation coefficients between characters were greater in magnitude than the phenotypic and environmental correlation coefficients. Higher genotypic correlation coefficient than the phenotypic correlation coefficient indicates low environmental effects on the expression of association between characters. Renuga (1999), Sindhumole and Ibrahim (2001) and Augustine Jerard (2002) also observed such trends in coconut. The traits *viz.*, number of female flowers per palm, number of inflorescence per palm, number of nuts per bunch, shell thickness, oil content, number of bunch, nut breadth, dehusked nut weight exhibited positive and significant correlation at both genotypic and phenotypic levels with number of nuts per palm (Table 3).

At genotypic level alone, the characters, number of leaves, petiole length and shell weight registered significant and positive correlation with yield. Hence, these characters could be considered as major yield contributing characters in coconut. The results are in consonance with the findings of Renuga (1999). Positive and significant correlation for number of nuts per bunch with number of female flowers was reported by Pieries (1934), Thampan (1970), Ballingasa and Caprio (1976) and Louis (1983), number of

inflorescence by Abeywardena (1976), number of nuts per bunch and oil content by Patil *et al.,* (1993b), number of leaves by Patel (1937), Satyabalan *et al.*, (1972), Abeywardena (1976) and Balakrishnan *et al.*, (1991).Sindhumole and Ibrahim (2001) and Selvaraju and Jayalekshmi (2011) reported yield had significant positive correlation with both vegetative and reproductive characters. Due emphasis should be given for these character in selection programme.

Plant height, length of leaf, number of leaflets (left), whole nut weight, kernel weight and kernel thickness also showed positive and non significant association with nut yield per palm. Similar results have also been reported for plant height by Satyabalan (1972), length of leaf and number of leaflets by Abeywardena (1976) and Sukumaran *et al.*, (1981) and kernel thickness by Louis (1983) and Patil *et al.,* (1993b). Negative and significant correlation was observed for stem girth with nut yield per palm indicating selection for stem girth is of minor importance. The results are in line with the findings of Ramanathan (1984), Renuga (1999) and Augustine Jerard (2002).

It is concluded that, variability studies are helpful in knowing the nature and extent of variability attributable to different causes, sensitive nature of the crop to the environmental influences, heritability of the character and genetic advance that can be involved in practical breeding. The extent of variability and heritability of characters among the genotypes are the basis for the exploitation of heterotic potentiality of the genotypes. The correlation between variables provided an idea of the degree of association existing among the different parameters measured. So selection based on one character will lead simultaneous improvement on other correlated character also. The genotypes with desirable characters can be profitably exploited in coconut improvement programme.It can be concluded that a wide range of variability and significant differences are existed between indigenous and exotic genotypes for various traits in the investigation. The results obtained from this study indicate that the indigenous and exotic coconut genotypes are important source of variability for most of the traits and can be effectively used in coconut improvement programme.

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