# REPORT 1999



**Cocoa Research Unit The University of the West Indies**  Annual Report 1999. St. Augustine, Trinidad and Tobago: Cocoa Research Unit, The University of the West Indies. 68 pp.



#### CRU's work is made possible by support from

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Cover photograph. Field 5A in the International Cocoa Genebank, Trinidad.

## **Annual Report 1999**



Cocoa Research Unit The University of the West Indies St. Augustine, Trinidad and Tobago 2000

### Assessing Genetic Diversity in the ICG,T using RAPD

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#### Introduction

Assessment of the genetic diversity in the ICG,T using molecular markers (RAPD) is still in progress. The results are being used to search for potential heterotic groups and may assist in the choice of a sub-sample from the ICG,T suitable for inclusion in a core collection. So far, three hundred and seventy-one clones, representing 27 cacao populations (from 4 to 23 clones per population) were analysed using RAPD (30 markers).

Table 1. Shannor	n indices (H	i) for t	the 27 cacao	populations	studied	using RAPD	analysis.
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Population	Group	Geographic origin	Sample size	Hi unbiased
AM	Refractario	Ecuador	15	0.32
AMAZ	Upper Amazon Forastero	Peru	8	0.42
В	Refractario	Ecuador	16	0.23
BORNE 7	Guianese	French Guiana	7	0.18
CC	Trinitario	Costa Rica	10	0.29
CL	Refractario	Ecuador	15	0.38
EET	Refractario	Ecuador	10	0.32
ELP	Guianese	French Guiana	19	0.28
EQX	Refractario	Ecuador	6	0.43
GS	Trinitario	Grenada	16	0.25
GU	Guianese	French Guiana	20	0.15
ICS	Trinitario	Trinidad	20	0.30
IMC	Upper Amazon Forastero	Peru	23	0.36
JA	Refractario	Ecuador	20	0.23
KER	Guianese	French Guiana	7	0.16
LCT EEN	Upper Amazon Forastero	Ecuador	20	0.45
MAR	Trinitario	Martinique	9	0.09
MO	Upper Amazon Forastero	Peru	14	0.37
MOQ	Refractario	Ecuador	7	0.36
NA	Upper Amazon Forastero	Peru	23	0.27
POUND	Upper Amazon Forastero	Peru	18	0.37
PA	Upper Amazon Forastero	Peru	21	0.34
SCA	Upper Amazon Forastero	Peru	14	0.39
SPA	Upper Amazon Forastero	Colombia	9	0.30
SPEC	Upper Amazon Forastero	Colombia	11	0.32
UF	Trinitario	Costa Rica	9	0.35
YAL	Guianese	French Guiana	4	0.27
TOTAL			371	0.30

#### Results

The data were used to assess the level of genetic diversity existing within each of the populations using the Shannon index (Hi) (Table 1) based on the number of markers showing polymorphism and their relative frequency. No correlation was found between Shannon indices and sample sizes.

Important differences are observed between the populations for their level of diversity:

- Refractario populations have levels of diversity ranging from rather low (B and JA) to high (CL and EQX)
- Populations from the Upper Amazon have levels of genetic diversity ranging from average (NA, SPA) to high (AMAZ, LCT EEN, SCA).
- Trinitario populations have levels of diversity ranging from very low (MAR) to rather high (UF).
- The populations from French Guiana have levels of diversity ranging from low (GU, KER, BORNE 7) to average (ELP, YAL).

The genetic relationships existing among these populations are depicted in a dendrogram obtained from cluster analysis performed on Rogers-Wright distances (Figure 1). The major trend shown by this figure is the very clear separation between populations from French Guiana (BORNE 7, ELP, KER, AND GU) and all the others.

Figure 1. Dendrogram depicting the genetic relationships among 27 cacao populations obtained from a cluster analysis (UPGMA = Unweighted Pair-Group Method using Arithmetic averages) performed on Rogers-Wright distances calculated from RAPD data.



Characterisation

Multivariate analyses (PCA) were performed separately on the two main groups revealed by the cluster analysis.

- The populations from French Guiana (Figure 2). Here the first two axes of the analysis allowed us to clearly differentiate three of the four clones collected on the banks of the Yaloupi river from all other Guianese clones analysed.
- All the other populations (Figure 3). This revealed a general separation between Forastero, on one hand, and Trinitario and Refractario on the other hand.

Figure 2. Plane defined by the first two axes of a PCA performed on RAPD data obtained from the study on 5 cacao populations from French Guiana.









Figure 4. Plane defined by the first two axes of a PCA performed on RAPD data obtained from the study on Upper Amazon Forastero populations.



AXIS 1 = 14.6% of the diversity

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Characterisation

The same type of analysis performed on the Trinitario and the Refractario populations failed to show any clear separation among the different populations or geographical origins (data not shown). On the other hand, there were clear trends for the Upper Amazon Forastero populations (Figure 4):

- The first axis allowed the differentiation of the MO and LCT EEN populations from the others.
- The second axis allowed the differentiation of the PA population from the other Peruvian populations (POUND, NA and IMC).

#### Conclusion

These results provide some indicators for strategies to improve cacao breeding schemes. The marked difference between cacao populations from French Guiana and all the other cacao populations in the study justifies the proposal made by Lachenaud (1997) to consider the French Guianese populations as a separate genetic group. For this reason, it would be interesting to try to increase the diversity of this group available for cacao germplasm collections. Steps towards this aim were taken in the last collecting expedition in French Guiana (Lachenaud *et al.*, 1997), when cacao from the banks of the Eleupousing and Yaloupi rivers were introduced, resulting in a larger diversity than that previously obtained along the banks of the Camopi river (Lachenaud and Sallée, 1993). Some of the clones from the banks of the Camopi river are already being tested for their combining ability with clones from other genetic groups in French Guiana, and it would be useful to enlarge this study to include the newly collected material.

Fairly clear separations could be observed between some Upper Amazon Forastero populations, which suggest the types of crosses that should be tested in places where only Upper Amazon Forastero progenitors can be used because of their resistance to disease. Indeed, it would be interesting to test crosses between clones from LCT EEN or MO and those from other Upper Amazon Forastero populations. In addition, crosses between PA clones and those from other Upper Amazon Forastero populations could be tested.

#### **Future direction**

This study will be continued, priority being given to the clones showing a high level of resistance to disease.

#### References

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