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CHARACTERISATION

Morphological Characterisation in the International Cocoa Genebank Trinidad- An Investment for the Future

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Reliable and useful characterisation and evaluation data are necessary for conserving and facilitating the utilisation of cacao germplasm. This paper is an overview of recent investigations at ICG,T based on morphological characterisation data. It identifies superior accessions, from among 314 from ICG,T, in terms of yield potential. Twenty-eight accessions with relatively low pod indices were identified, some of which display other traits of economic interest at ICG,T and abroad. The results of a comparison of the classification patterns obtained using quantitative and qualitative morphological descriptors are also presented. The lack of correspondence between the distance matrices obtained using the two kinds of morphological descriptors suggests that the information provided by each is distinct. The continued use of both types of descriptors is therefore recommended.

The International Cocoa Genebank, Trinidad (ICG,T) conserves *ex situ* some of the most diverse cacao germplasm. It serves as an insurance against future erosion or devastation of cacao genetic resources due to deforestation in the Amazon forests or pests and diseases. Without characterisation information, the genebank will be "as useless as pills without labels". Properly identified and characterized accessions not only facilitate utilisation, but also future collecting to safeguard endangered germplasm. They allow the identification of gaps in *ex situ* collections.

The existing characterisation programme at CRU involves routine collation of morphological and biochemical (isozyme and RAPD) data. The data that are being generated and stored in the ICG,T can be easily accessed through CRU's database and the *International Cocoa Germplasm Database* (End *et al.*, 1992) so that useful accessions may be identified.

Over the years, efforts have been made to consult with experts, and to further analyse the morphological data accrued (Bekele and Bekele, 1995; 1996; Bekele *et al.*, 1994) in order to determine the suitability of the short list used at CRU for routine characterisation. This is to ensure that enough useful information for identification, characterisation and assessing diversity is recorded.

Recent Investigations

Comparison of diversity patterns based on morphological and molecular data

A comparison of the diversity obtained using morphological markers and molecular and biochemical markers was undertaken by Sounigo *et al.*, and the results are presented in the paper below. The taxonomic distance matrices generated using quantitative and qualitative data from the short list, respectively, were compared with the genetic distance matrices generated using RAPD and isozyme data. No significant correlations were obtained. This suggests that molecular and morphological data yield different information about individual accessions, as is discussed in the paper below.

Comparison of diversity patterns based on quantitative and qualitative morphological data

Taxonomic distance matrices, based on the Euclidean Distance measure, were generated from qualitative and quantitative morphological data representing 134 accessions from 14 cacao populations. There was no significant correlation between the matrices. It may be inferred that the information contributed by each class of data is distinct, and both must be used for a complete description of the germplasm.

Verification of homogeneity within single accession plots at the University Cocoa Research Station (UCRS)

Floral, fruit and flush colour characteristics of trees within accession plots at UCRS were examined. Leaf samples, from trees judged to have the same phenotype, were then collected for further analysis using the RAPD technique. The results will be presented in CRU's Annual Report for 1998. This exercise is critical for ensuring the integrity of the conservation plots at the UCRS.

Selection of accessions with superior yield potential

Three hundred and fourteen accessions, representing 45 cacao populations of diverse origin, were studied in terms of fruit characteristics. Of these, 28 (9%) had pod indices of 20 or less (Table 1). The variation in this character was significant between accessions and populations ($P < 0.0001$). Only three additional accessions with pod indices less than 20 were found in this study compared to an earlier one involving 237 accessions (Bekele *et al.*, 1996).

Since pod index is an indicator of yield, accessions with low pod indices are interesting to breeders. As such, they may be included in the germplasm enhancement programme of the Project, "*Cocoa Germplasm Utilisation and Conservation: A Global Approach*" (Sounigo *et al.*, 1998). This Project is an example of "*investing for the future*".

Table 1. Accessions with low pod indices (< 20)

Accession	Pod Index
CL 27.50 (Refractario - selected for Witches' Broom resistance)	19.6
EET 59*, 272, 395, 397	17.6, 20.2, 17.4, 18.9
ICS 1, 5, 43, 60*, 68, 75, 85*, 111**	19.7, 17.0, 19.0, 16.5, 15.6, 19.1, 18.1, 19.6
IMC 3, 10, 65, 68, 97	18.8, 19.1, 19.1, 19.3, 17.1
JA 55, 531, 539	18.3, 16.5, 23.4
MATINA 1-7	18.8
P 18*	39.4
SCA 9*	19.7
SJ 222 (Refractario - selected for Witches' Broom resistance)	19.9
UF 11, 12*, 29	14.9, 15.6, 19.6

* Other traits of economic interest have been recorded at ICG,T and abroad (Bekele *et al.*, 1996).

Accessions in bold were not included in the former study (Bekele *et al.*, 1996).

** ICS 111 is a cross between ICS 1 and 6. It featured prominently in Progeny Trial 4 at Las Hermanas, Trinidad (Bartley and Chalmers, 1970). It had a high wet bean weight per pod and was found to be the best parent in terms of combining ability for yield.

In **bold** - accessions characterised this year

Pod Index - Number of pods which produce 1000g of dried beans (without testa)

Future Prospects

Routine characterisation of the germplasm at ICG,T will be continued. Further efforts will be made to

hasten the rate of data accumulation. This may involve a further reduction of the short list of descriptors presently in use if the complement of staff cannot be augmented along with an appropriate expansion of the facilities. In a continued effort to ensure the suitability of the short list for routine characterisation, Multivariate Analytical techniques will be used. Flower and fruit descriptors will be further analysed and ranked in terms of their contribution to the variation expressed in the study population.

The data generated will be continuously analysed in order to gain insights into the inter-relationships among the accessions, and the level of diversity present. Further investigations will be undertaken to determine whether there is congruence between the classifications obtained using morphological and molecular/biochemical data. Preliminary evaluation using characters of economic interest will continue. This activity will coincide with the objectives of the CFC Project. The Project also creates an opportunity to systematically study the role of environment on the expression of phenotypic characters in cacao.

Genebank activities such as those described herein are investments to ensure that the world's cocoa industry is not jeopardised in the future by unexpected devastation of cacao plantings. They are designed to meet future needs of producers and consumers alike.

References

- Bartley, B.G.D. and Chalmers, W. (1970) Genetics and Breeding, in: *Annual Report of Cacao Research*, University of the West Indies, p 7-13
- Bekele, F.L. and Bekele, I. (1995) Further studies on a concise list of morphological descriptors for cacao, in: *Proc. of the International Workshop on Cocoa Breeding Strategies*, Kuala Lumpur, Malaysia, October 18-19, 1994, pp. 155-165
- Bekele, F.L. and Bekele, I. (1996) A sampling of the phenetic diversity in the International Cocoa Genebank of Trinidad, *Crop Science* 36 (1) 57-64
- Bekele, F.L., A.J. Kennedy, C. Mc David, B. Lauckner and I. Bekele. (1994). Numerical taxonomic studies on cacao (*Theobroma cacao* L.) in Trinidad, *Euphytica* 75: 231-240
- Bekele, F.L., Iwaro, D. and Bidaisee, G. (1996) Evaluation of some economic characters of germplasm from the International Cocoa Genebank, Trinidad, in: *Annual Report of the Cocoa Research Unit for 1996*, p 19-33
- End, M.J., Wadsworth, R.M. and Hadley, P. (1992) International Cocoa Germplasm Database. B.C.C.C.A./University of Reading, B.C.C.C.A., London, 355 pp
- Sounigo, O., Mooleedhar, V., Iwaro, D., Bekele, F.L., Sreenivasan, T.N., Thévenin, J.M., Khan, N. and Butler, D. (1998) Proposed strategy for the establishment of a "Working Collection" for the CFC Project. Paper presented at the Workshop for the Project entitled *Cocoa Germplasm Utilization and Conservation: A Global Approach*, funded by the Common Fund for Commodities, Montpellier, France, February 1-7, 1998