Collecting Wild *Coffea* Species in Kenya and Tanzania

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Introduction

For several years, Institut Français de Recherche pour le Développement en Coopération (ORSTOM) and IRCC (Institut de Recherche sur le Café et le Cacao) have had a cooperative programme for genetic improvement of coffee. The following collecting trips have been made in Africa, for germplasm of the genus Coffea:

1. Ethiopia (1966) for C. arabica (Guillaumet and Halle, 1978);
2. Central Africa (1975) for C. canephora, C. congensis, C. liberica and "caféier de la Nana" (Berthaud and Guillaumet, 1978);
3. Côte d'Ivoire (1975-1981) for C. canephora, C. humilis, C. liberica and C. stenophylla (Berthaud, 1984);
4. Cameroon (1983) for C. brevipes, C. canephora, C. liberica and C. staudtii (Anthony et al., 1985); and
5. Congo (1986) for C. brevipes, C. canephora, C. congensis and C. liberica.

East Africa is a particularly interesting area for Coffea collection because it contains species of section Mozambicoffea (Chevalier, 1947) which seems to be an evolutionary link between the high caffeine Eucoffea group and the caffeine-free Mascarocoffea group. Our knowledge of this group is limited and many of them are not represented in field genebanks. The species C. eugenioides (Charrier, 1978) and its relationship with C. arabica, is of particular interest.

Two collecting missions to East Africa were undertaken, the first in Kenya from 12-17 January, 1977 (Berthaud et al., 1980) and the second in Tanzania from 5 March-11 April, 1982 (Berthaud et al., 1983). The team consisted of a botanist, two geneticists and a plant pathologist.

Methods

The herbaria of the Museum National d'Histoire Naturelle, Paris, France, the Royal Botanical Gardens, Kew, UK and the Jardin Botanique Royal, Meise, Belgium were visited prior to the collecting trips in order to develop species/location lists. The species which were expected in Kenya were C. eugenioides, C. zanguebariae and some undetermined species; while in Tanzania they were C. eugenioides, C. mufindiensis, C. racemosa, C. schumanianna and C. zanguebariae.

Additional information was obtained from the National Herbarium of Kenya at Nairobi, especially on C. arabica in the Marsabit area mentioned by Dale and Greenway (1961), and on an undetermined species described as C. fadenii by Bridson (1982). Other data were provided by specialists of the Coffee Research Station at Ruiru (Kenya) and the Sylviculture Research Station at Lushoto (Tanzania). Itineraries were established based on known sites of wild coffee trees, transportation facilities and local difficulties. The general methodology for collecting was described by Berthaud et al. (1980; 1984).

Results

Collections were made as cuttings,

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Table 1. Coffee germplasm collected in Kenya in 1977

Species and population	Size of sample	Type of material 1/
C. arabica		
Marsabit	84	C, YP, S
C. eugenioides		
Kimilili	8	C, YP, S
Malawa	174	C, YP, S
North Nandi	117	C, YP, S, SL
Kaptarol		YP, S
Teressia	539	C, YP, S
Kambiri	88	C, YP, S
Cheptuyet	354	C, YP, S, SL
C. fadenii		
Mbololo	40	C, YP, S, SL
C. zanguebariae		
Longo Magadi	41	C, YP, S
Shimba Hills		
Diani	19	C, YP
Shimoni	38	C, YP
Rabai	9	C

1/ C= cuttings; S= seeds; SL= seedlings; YP= young plants

young plants, shoots, seedlings and seeds, and herbarium samples were prepared of every population. The accessions collected are listed in Tables 1 and 2, while their locations are given in Berthaud et al. (1980; 1983).

1. C. arabica L. (Kenya)

This species was only found in the Marsabit Forest, at an altitude of 1500-1550 m where it was already known and considered as "probably genuine wild" by its collector (cited in Dale and Greenway, 1961). It forms numerous small populations often of very vigorous young plants with some older trees. The Marsabit forest may be the southernmost limit of its natural distribution.

2. C. eugenioides S. Moore (Kenya)

This species was found only in the area east of Lake Victoria between 1600 and 2200 m of altitude, in lowland forest of the Lake Victoria belt (Lind and Morrison, 1974). In some places C. eugenioides was the most common understory species. The large numbers of plants and their quite uniform spatial distribution made observation of population structure difficult. Some variation in size and shape of leaves occurred between individuals of the same population. Additionally, there was variability in fruit maturity both within and between populations. This species was not found around Mount Kenya, where it had been reported previously, because of large-scale forest destruction.

3. C. fadenii Bridson (Kenya)

This species was undescribed at the time of our visit. Faden and Faden first reported it on top of the Taita Hills near

Table 2. Coffee germplasm collected in Tanzania in 1982

Species and population	Size of sample	Type of material 1/
C. zanguebariae		
Utete 1	23	C
Utete 2	6	C
Utete 3	2	C
Utete 4	6	YP
Mkongo	20	C
Kitulangalo	22	C
Kitulangalo	27	C
Uzigua 1	30	C
Uzigua 2	28	C
Uzigua 2	307	SL
C. mufindiensis		
Mamiwa 1	20	C
Mamiwa 1	11	YP
Mamiwa 1	32	S
Mamiwa 2	44	C
Mamiwa 2	79	S
Mufindi 1	104	YP
Mufindi 2	37	C
Mufindi 2	19	SL

1/ C= cuttings; S= seeds; SL= seedlings; YP= young plants

1500 m in 1971. We found one tree of about 20 m high and with a circumference of 1.1 m bearing many fruits and surrounded by numerous seedlings, and by abundant plants at all developmental stages. The tree was very vigorous and was similar to species of Mascarocoffea in fruit and leaf shape, and in leaf and stem colour.

4. C. zanguebariae species complex (Kenya and Tanzania)

Four populations of this species complex were found in Kenya and three in Tanzania. Identification was difficult because the plants often lacked flowers or fruits, and because of the great variation in coffee tree morphology in this part of Africa.

(a) Diani and Shimoni (Kenya)

Coffee trees from these two populations were identified as C. pseudozanguebariae Bridson (Bridson, 1982). These scarce trees were widely dispersed in the coastal dry forest on a coral reef substrate. Most had developed several shoots as an adaptation to the substrate.

(b) Rabai (Kenya)

This population (form C. pseudozanguebariae) was found in a small patch of woody vegetation near a stream.

(c) Shimba hills (Kenya)

Located in coastal hills, at an altitude of 150-350 m, these populations belonged to a completely different vegetation type - rainforest with a more complex stratification and a greater species diversity. In these populations, two forms were found: C. pseudozanguebariae and C. sp. "A".

(d) Utete (Tanzania)

Several small populations were

collected in forest patches situated in a woody savannah at an altitude of 50-150 m These populations consisted only of adult trees and lacked flowers and fruits. The absence of seedlings and young plants showed a poor reproductive capacity. Plants were very different from those of other sites in leaf shape and size.

(e) Morogoro (Tanzania)

This population, situated on a hill slope, at an altitude of 500 m, was composed of young plants and adult trees bearing flowers and some mature fruits. The absence of seedlings could have resulted from irregular flowering.

(f) Uzigua (Tanzania)

As at Utete, populations were situated in forest patches in a woody savannah. Though plants had no flowers or fruits, seedlings well aggregated under some adult trees were found. The heterogeneity of seedling distribution may indicate high variability in parent tree reproductive ability. Several trees also produced suckers.

It is suggested that the morphological characteristics and location in low altitude forest of the coffee trees of the three Tanzanian sites indicates that they belong to the C. zanguebariae species complex. Study of the full reproductive cycle in collected material and examination of morphological and biochemical characteristics using electrophoresis will enable the taxonomic position of collected samples and biological relationships within and between populations to be determined.

5. C. mufindiensis species complex (Tanzania)

(a) Mamiwa

Two populations were found in summit forests in the Rubeo Mountains at an altitude of 1600-1700 m, an area from which coffee had previously been collected. Both juvenile and adult plants were numerous, and many bore unripe fruits. Morphological variability was low among individuals.

(b) Mufindi

Two populations were found in very different forest types on the Mufindi Escarpment, at an altitude of 1750 m. The first one (T05) grew in a bamboo forest. This well delimited population included numerous plants of different ages, bearing many fruits. The second one (T06), in a rainforest, was also well delimited with many fruiting adult and some young trees, and many seedlings. These two populations showed strong reproductive potential. There was considerable morphological variability both between and within the populations.

The habitat of the two C. mufindiensis populations is high altitude rainforest. Because of their morphological characteristics and their ecological status, they appeared very similar to C. mufindiensis as defined by Chevalier (1947) although they shared some similarities with other species like C. eugenioides, C. racemosa and C. zanguebariae. The collections will be studied further to clarify their taxonomic status.

Phytosanitary observations

All the populations observed in Tanzania were free of major diseases. Some secondary infection or damage, common in forest conditions, such as Corticium koleroga (Cke) Höhn on branches or leaves, and leaf miners, was present, apparently without serious effects.

Two of the major diseases of coffee, leaf rust (Hemileia vastatrix B. and Br.) and coffee berry disease (Colletotrichum coffeanum Noack) were observed in Kenya. The leaf rust occurred in two populations of C. eugenioides, at Kambiri and Cheptuyet. At Cheptuyet, many plants have a high infection rate with typical leaf rust spots. The berry disease occurred rarely on some plants from Kimilili and Malawa. Mites and leaf miners were common in many populations but might be considered as secondary; they often occur on numerous plants of rainforests.

All plant samples collected were processed to eliminate infected organs, and then treated with pesticides to protect the material during transfer to quarantine facilities.

Work at the field genebanks

Part of the collection was sent to the

coffee research stations of Kenya (Ruiru) and Tanzania (Lyamungu). The other part was sent to ORSTOM and IRCC in Côte d'Ivoire.

To prevent dissemination of pests and diseases from East to West Africa, the material was first sent to Montpellier, France for six months quarantine, and then to a special quarantine glasshouse at Abidjan, Côte d'Ivoire for three months.

During quarantine, the material was propagated by grafting on C. canephora,

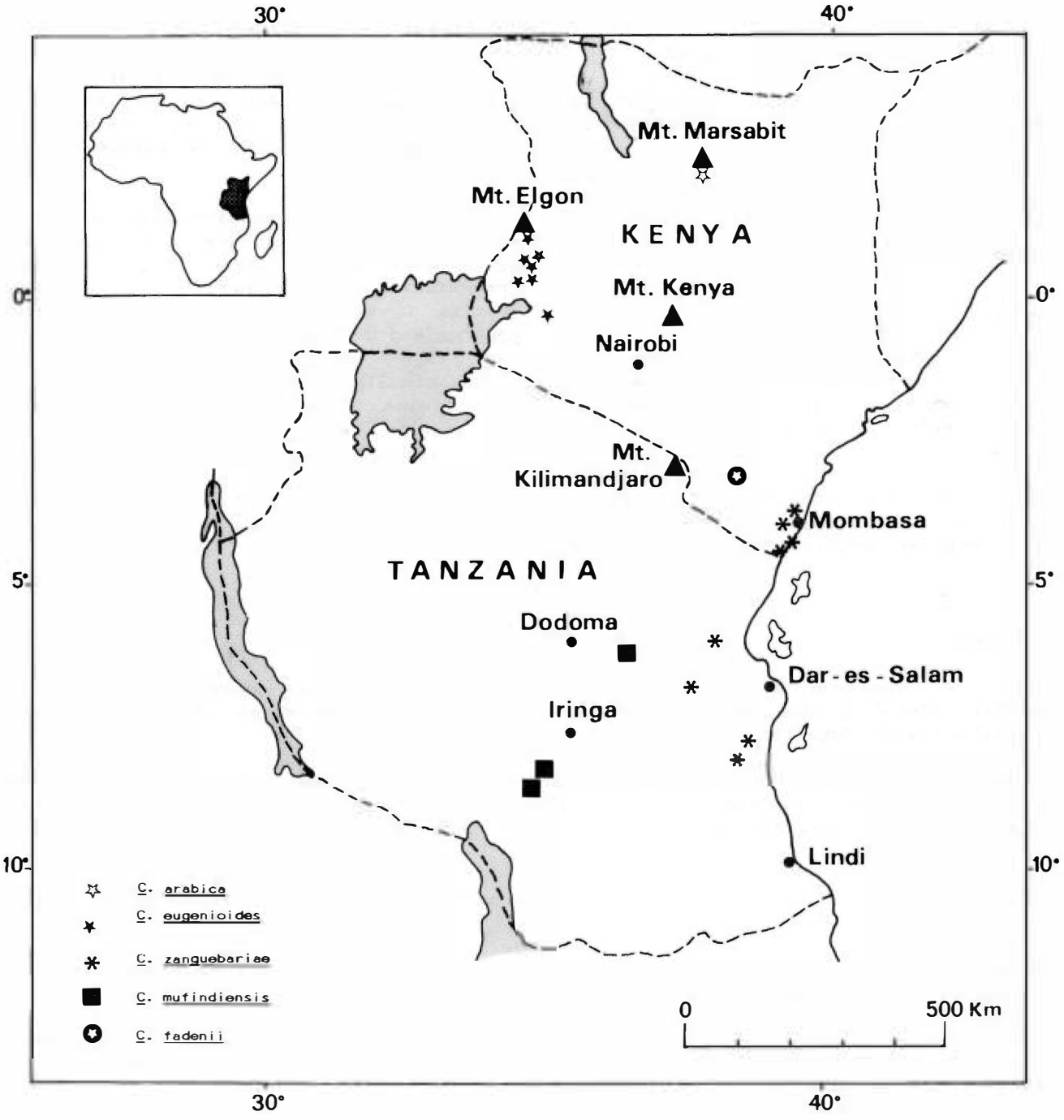

Fig. 1. ORSTOM mission coffee collecting sites in East Africa

directly from cuttings and from seedlings, either collected or grown from seed (Berthaud et al., 1980). Possible problems with root disease were reduced or eliminated by growing grafted plants. After the quarantine periods, plants were transferred to the germplasm collections at two experimental stations in Côte d'Ivoire: at Mount Tonkoui at 1100 m for species from mountain areas; and Divo at 250 m altitude for other species, where genetic studies are now in progress.

Some of the data resulting from the evaluation of these collections has now been published. Hamon et al. (1984) described the relationship between different forms of C. zanguebariae. Berthaud (1984) proposed new relationships within and among sections of the genus Coffea based on this material.

Conclusions

The main objective of the missions to Kenya and Tanzania was to broaden the genetic basis of material available for coffee breeding. There are now over 1500 genotypes of five or more species of the Mozambicoffea section of the genus Coffea in Côte d'Ivoire. The collections are a useful basis for studying Coffea taxonomy, the genetic variability of specific groups and the genetic structure of the genepool. The relationship between C. arabica and C. eugenioides has been investigated by electrophoresis and organelle DNA analysis (Berthaud et al., 1977; 1983).

Plants of C. eugenioides and of the C. zanguebariae species complex have been shown to have a lower caffeine content than those of C. arabica.

Caffeine-free representatives of C. pseudozanguebariae have even been found, a characteristic once thought typical of Mascarocoffea, the group of native coffee plants of Madagascar.

Further genetic studies are currently in progress, including interspecific hybridizations to analyze and improve transmission of valuable traits into species of agronomic interest such as C. arabica and C. canephora.

Uncontrolled forest exploitation in East Africa is having serious effects on the genetic resources of Coffea species. Many forests previously reported to have wild coffees have nearly disappeared. It is urgent now to conserve selected forest areas for plant resources as suggested by Charrier (1980).

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RESUME

Plus de 30 populations d'espèces de Coffea comprenants C. arabica, C. eugenioides, C. fadenii, et des espèces non identifiés parentes des groupes C. zanguebariae and C. mufindiensis ont été collectées au Kenya en 1977 et en Tanzanie en 1982. Le materiel collecté fût distribué à des collections en champ au Kenya et en Tanzanie et en Côte d,Ivoire via des procedures de quanrantaine.

RESUMEN

Más de 30 poblaciones de Coffea, comprendiendo C. arabica, C. eugenioides y especies indeterminadas relacionadas con grupos de C. zanguebariae y C. mufindiensis, fueron recolectadas en Kenia en 1977 y en Tanzania en 1982. El material recolectado fue dividido entre diversos bancos de germoplasma en Kenia y Tanzania y mediante métodos de cuarentena a Costa de Marfil.

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