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Coffee Wilt Disease: a major constraint to coffee production in Africa



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Coffea canephora and C. arabica culture are one of the main economic resources for some African countries. Coffee Wilt Disease (CWD), a vascular disease due to the fungus *Gibberella xylarioides* (anamorph *Fusarium xylarioides*), cause drastic damage.

Introduction

CWD was first observed on *Coffea excelsa* in Central Africa Republic (CAR) in 1927. From the 1940s to the 1960s the disease caused considerable destruction to *C. excelsa* and *C. canephora* in Central and West Africa, killing trees within two months to two years of the first appearance of symptoms. Systematic elimination of affected plants over vast areas and deployment of resistant varieties virtually eradicated CWD in these regions. However, in the late 1970s CWD "re-appeared" on *C. canephora* in Northeast Democratic Republic of Congo (DRC), and was subsequently reported in neighbouring Uganda (1993) and Tanzania (2000) causing renewed and extensive damage. In Uganda alone, where *C. canephora* accounts for 85% of exported coffee, CWD has destroyed 120 million (45%) trees and reduced the country's share of the international market from 7% to 3% in just 10 years. *C. arabica*, although also cultivated in these countries, remains unaffected despite CWD having caused damage to *C. arabica* in Ethiopia since 1957.

Given the limitations of phytosanitary control methods, the need to avoid replanting on infected soil and the current lack of commercially available resistant cultivars, host resistance forms the basis of any long-term, sustainable solution to CWD. A major breeding programme is therefore underway, supported by an in-depth study of pathogen variability. Key findings of this study are presented here.

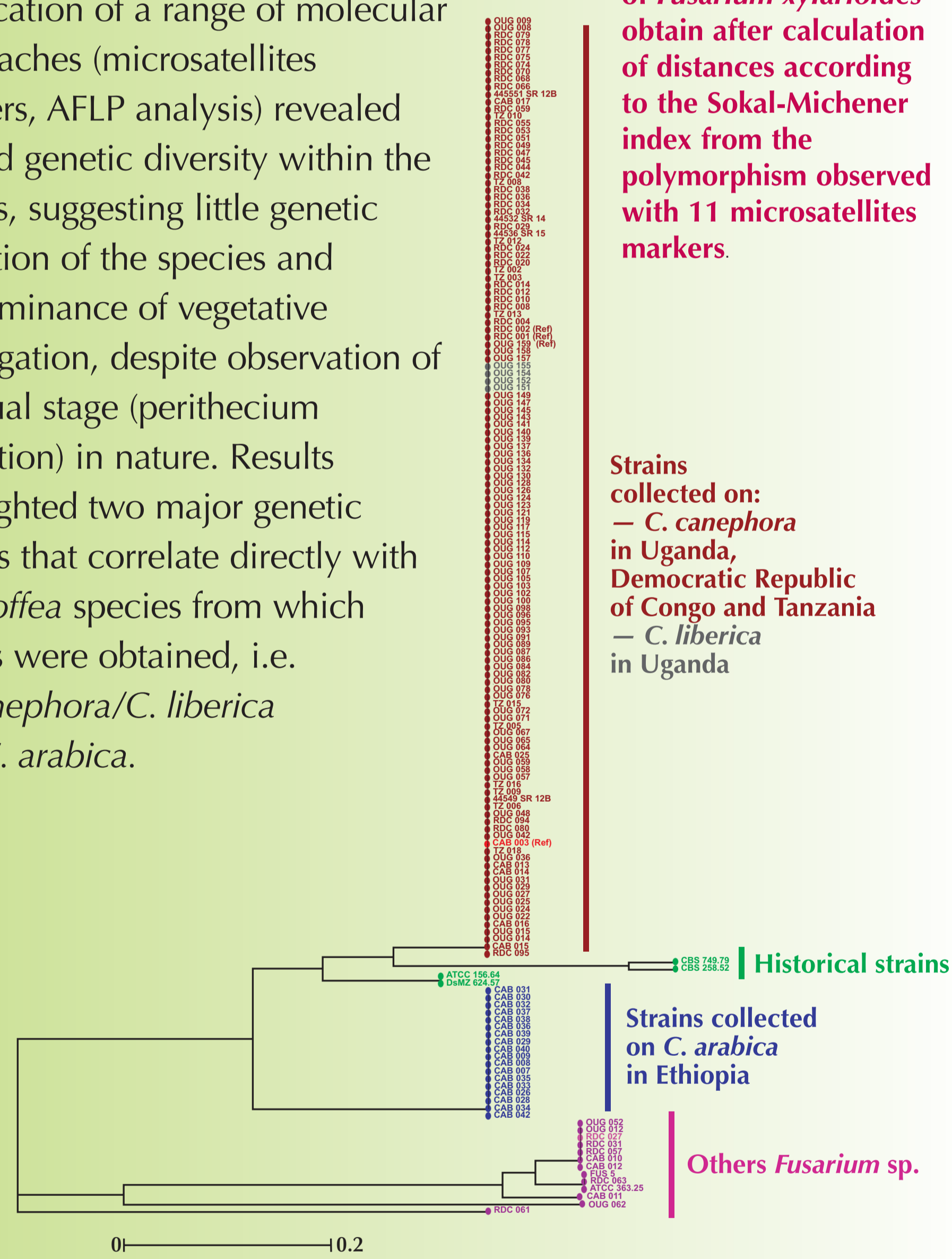
Results and Discussion

Application of a range of molecular approaches (microsatellites markers, AFLP analysis) revealed limited genetic diversity within the fungus, suggesting little genetic evolution of the species and predominance of vegetative propagation, despite observation of a sexual stage (perithecium formation) in nature. Results highlighted two major genetic groups that correlate directly with the *Coffea* species from which strains were obtained, i.e. *C. canephora*/*C. liberica* and *C. arabica*.

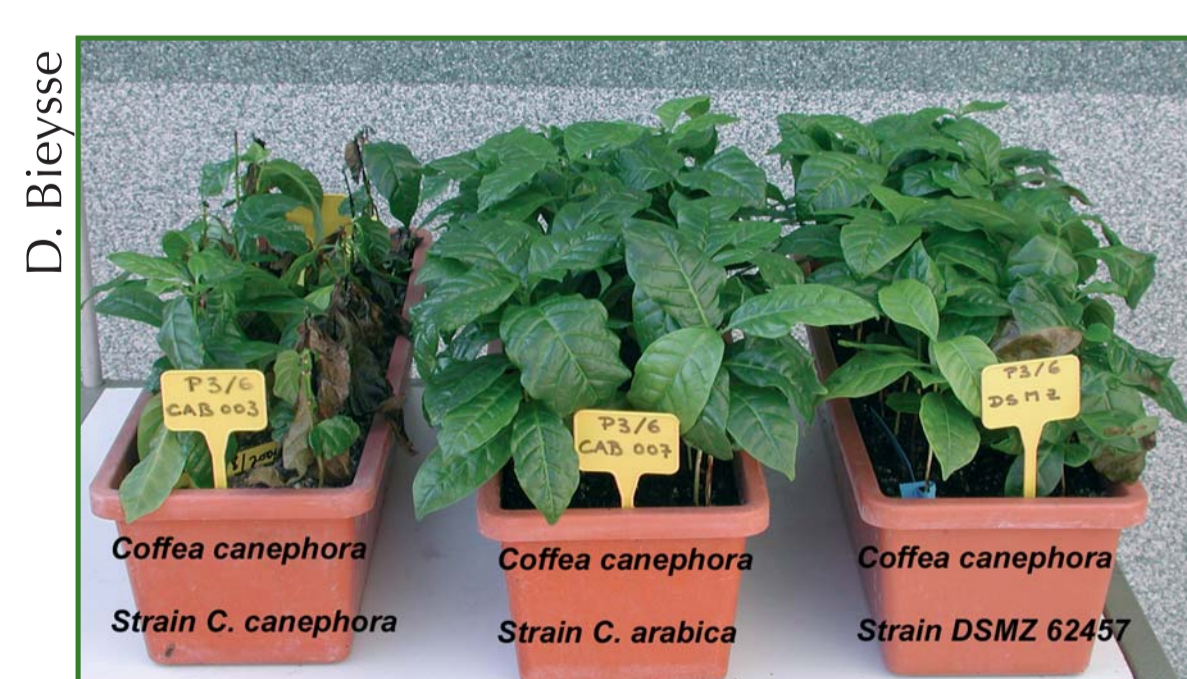
Genetic diversity of *Fusarium xylarioides* obtain after calculation of distances according to the Sokal-Michener index from the polymorphism observed with 11 microsatellites markers.

Strains collected on:

- *C. canephora* in Uganda, Democratic Republic of Congo and Tanzania
- *C. liberica* in Uganda



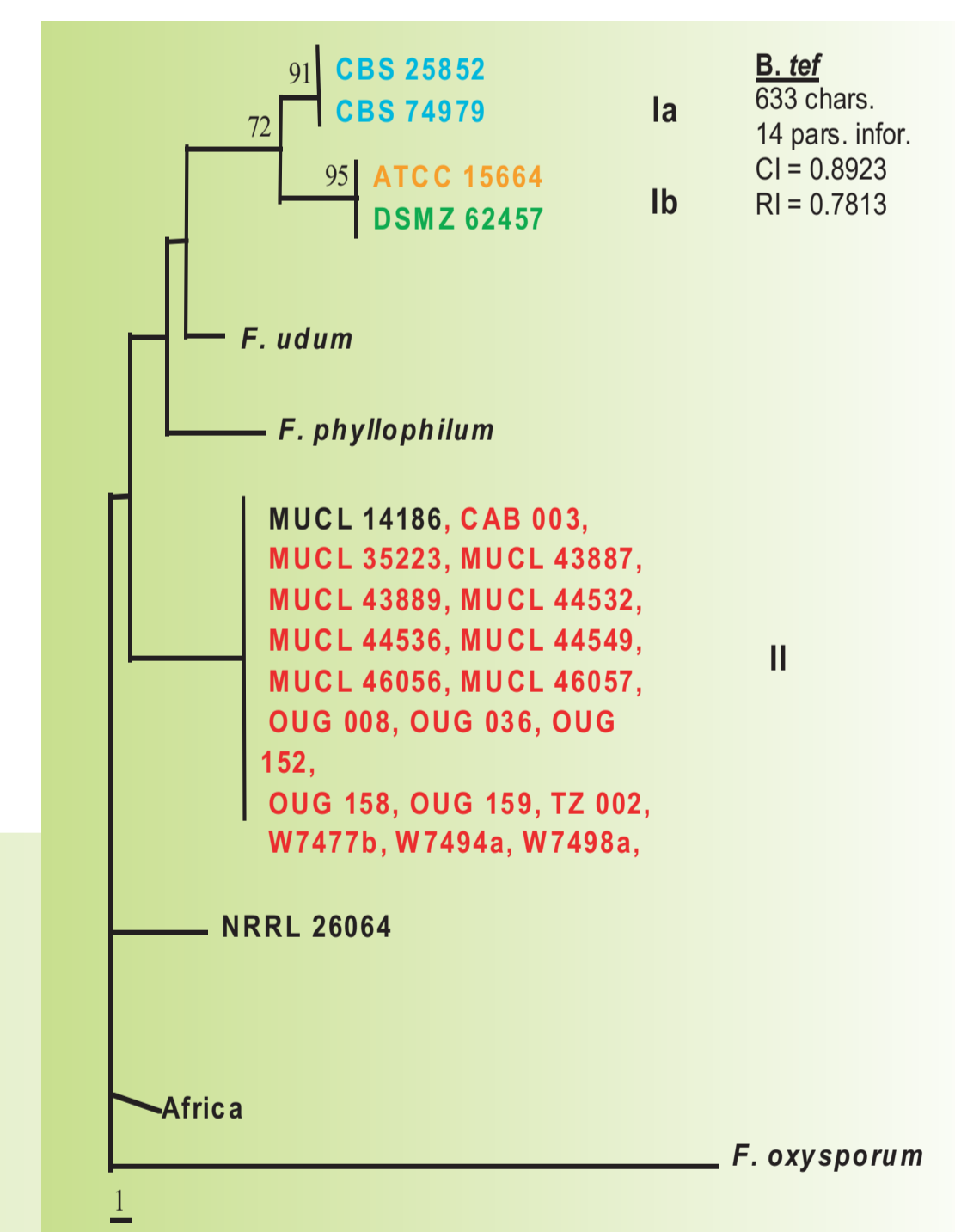
Furthermore, strains obtained from *C. arabica* and *C. canephora* induced CWD symptoms only on their respective host species when challenged against coffee seedlings of a range of differing species, suggesting strict host specificity. However, inoculation with clade Ib strain DSMZ 62457, obtained from *C. excelsa* in CAR, induced symptoms not only on *C. excelsa* but also on *C. canephora* and *C. arabica*. This suggests that some strains may display a larger host range encompassing not only one but several cultivated *Coffea* species.



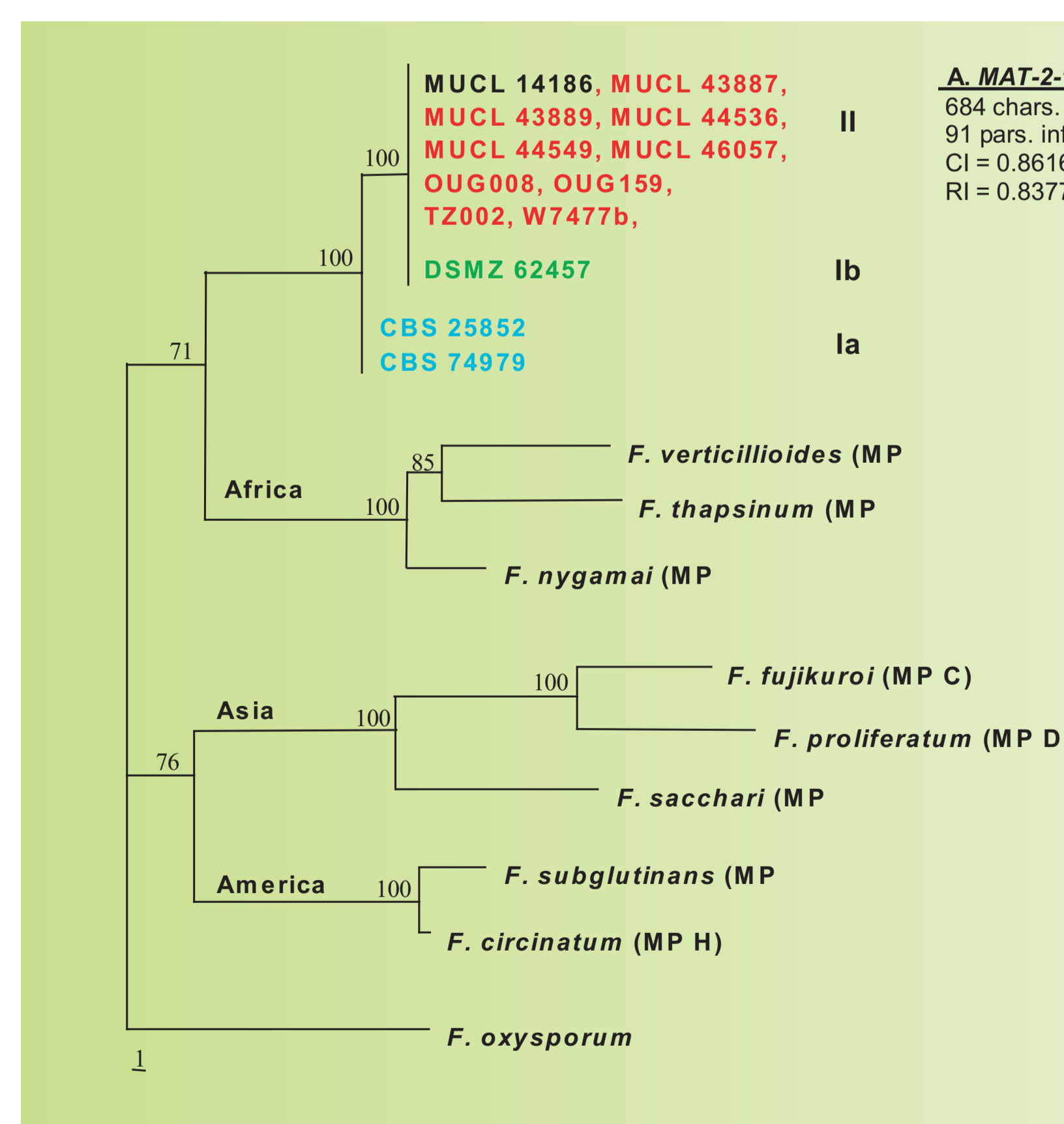
Specific reaction of *C. canephora* seedlings inoculated with 3 isolates collected on *C. canephora*, *C. arabica* and *C. excelsa*.

In vitro crossing assays and molecular studies of Congolese, Ugandan, and Tanzanian *C. canephora*/*C. excelsa*-associated strains demonstrated a bipolar heterothallic mating system (*MAT-1*, *MAT-2*) within *G. xylarioides*. Moreover, these recently isolated strains are sexually compatible and identical in mating type (*MAT*) and translation elongation factor 1- (*tef*) sequences to Congolese strain MUCL 14186 isolated in 1960 from *C. canephora*. Crossing assays coupled with the phylogenetic analyses of partial *MAT-2* and *tef* sequence data were equally carried out on *C. canephora*/*C. excelsa*-associated strains isolated in the 1950s-60s in the CAR, Côte d'Ivoire and Guinea. Results suggest that *G. xylarioides* encompasses at least three distinct clades (Lepoint *et al.*, 2005) placed within the African (Af) clade of the *G. fujikuroi* species complex (GFC) *sensu* O'Donnell of which Ia and Ib were not longer reported the last 25 years:

- Clade Ia: West African strains (Guinea, Côte d'Ivoire) dating from the 1950s to the 1960s.
- Clade Ib: Central African strains (CAR) dating from the 1950s to the 1960s.
- Clade II: Congolese, Ugandan, and Tanzanian *C. canephora*/*C. excelsa*-associated strains dating from 1960 to 2002.



Maximum-parsimony phylograms based on partial *MAT-2* and *tef* gene sequences of species belonging to the *G. fujikuroi* species complex including representative coffee wilt isolates from *Coffea canephora* and *C. excelsa*.



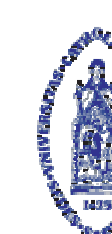
Strain	Host	Year
MUCL 14186	DRC	1960
DSMZ 62457	CAR	1960
CBS 25852	Ivory Coast	1951
CBS 74979	Guinea	1963
ATCC 15664	?	?
-----	DRC	1997 - 2003
-----	Uganda	1997 - 2003
-----	Tanzania	

Conclusion

The findings of this work are of fundamental importance to the future management of CWD and in safeguarding the livelihoods of millions of smallholder coffee farmers across the African continent.

This project has been funded by UE INCO Programme.

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