Annals of Botany **XX**: 1–13, 2024
https://doi.org/10.1093/aob/mcae034, available online at www.academic.oup.com/aob

ANNALS OF BOTANY
Founded 1887

RESEARCH IN CONTEXT

Crop-to-wild gene flow in wild coffee species: the case of *Coffea canephora* in the Democratic Republic of the Congo

Lauren Verleysen[1,2,†], Jonas Depecker[1,3,4,*,†], Robrecht Bollen[1,3], Justin Asimonyio[5], Yves Hatangi[3,6,7], Jean-Léon Kambale[5], Ithe Mwanga Mwanga[8], Thsimi Ebele[9], Benoit Dhed'a[6], Piet Stoffelen[3], Tom Ruttink[2,10], Filip Vandelook[1,3] and Olivier Honnay[1,4]

[1]Division of Ecology, Evolution and Biodiversity Conservation, KU Leuven, Leuven, Belgium, [2]Plant Sciences Unit, Flanders Research Institute for Agriculture, Fisheries and Food (ILVO), Melle, Belgium, [3]Meise Botanic Garden, Meise, Belgium, [4]KU Leuven Plant Institute, Leuven, Belgium, [5]Centre de Surveillance de la Biodiversité et Université de Kisangani, Kisangani, DR Congo, [6]Université de Kisangani, Kisangani, DR Congo, [7]Liège University, Gembloux Agro-Bio Tech, Gembloux, Belgium, [8]Centre de Recherche en Science Naturelles, Lwiro, DR Congo, [9]Institut National des Etudes et Recherches Agronomique, Yangambi, DR Congo and [10]Department of Plant Biotechnology and Bioinformatics, Ghent University, Ghent, Belgium
[†]These authors contributed equally to this work.
[*]For correspondence: E-mail jonas.depecker@kuleuven.be

Received: 22 January 2024 Editorial decision: 28 February 2024 Accepted: 1 March 2024

• **Background and Aims** Plant breeders are increasingly turning to crop wild relatives (CWRs) to ensure food security in a rapidly changing environment. However, CWR populations are confronted with various human-induced threats, including hybridization with their nearby cultivated crops. This might be a particular problem for wild coffee species, which often occur near coffee cultivation areas. Here, we briefly review the evidence for wild *Coffea arabica* (cultivated as Arabica coffee) and *Coffea canephora* (cultivated as Robusta coffee) and then focused on *C. canephora* in the Yangambi region in the Democratic Republic of the Congo. There, we examined the geographical distribution of cultivated *C. canephora* and the incidence of hybridization between cultivated and wild individuals within the rainforest.
• **Methods** We collected 71 *C. canephora* individuals from home gardens and 12 *C. canephora* individuals from the tropical rainforest in the Yangambi region and genotyped them using genotyping-by-sequencing (GBS). We compared the fingerprints with existing GBS data from 388 *C. canephora* individuals from natural tropical rainforests and the INERA Coffee Collection, a Robusta coffee field gene bank and the most probable source of cultivated genotypes in the area. We then established robust diagnostic fingerprints that genetically differentiate cultivated from wild coffee, identified cultivated–wild hybrids and mapped their geographical position in the rainforest.
• **Key Results** We identified cultivated genotypes and cultivated–wild hybrids in zones with clear anthropogenic activity, and where cultivated *C. canephora* in home gardens may serve as a source for crop-to-wild gene flow. We found relatively few hybrids and backcrosses in the rainforests.
• **Conclusions** The cultivation of *C. canephora* in close proximity to its wild gene pool has led to cultivated genotypes and cultivated–wild hybrids appearing within the natural habitats of *C. canephora*. Yet, given the high genetic similarity between the cultivated and wild gene pool, together with the relatively low incidence of hybridization, our results indicate that the overall impact in terms of risk of introgression remains limited so far.

Key words: *Coffea canephora*, Robusta coffee, crop wild relatives (CWRs), cultivated–wild hybridization, Congo Basin, field gene bank, gene flow, introgression.

INTRODUCTION

A growing human population in an increasingly warmer world may jeopardize the food security of many households (FAO, 2018; Bohra *et al*., 2022). To cope with this future challenge, innovations in plant breeding and agricultural systems are an important part of the solution (Zhang *et al*., 2017; Bohra *et al*., 2022). Crop improvement should focus on increasing yields, enhancing crop climate change resilience and providing nutritional security (Brozynska *et al*., 2016). To do so, plant breeders can fall back on crop wild relatives (CWRs), which harbour genetic diversity that is not present in their cultivated relatives, and may underlie desirable traits, including resistance to pests and diseases, and tolerance to abiotic stresses (Heywood *et al*., 2007; Zhang *et al*., 2017; Saeed and Fatima, 2021). Conservation of the genetic resources in populations of

© The Author(s) 2024. Published by Oxford University Press on behalf of the Annals of Botany Company.
All rights reserved. For permissions, please e-mail: journals.permissions@oup.com.

Downloaded from https://academic.oup.com/aob/advance-article/doi/10.1093/aob/mcae034/7619228 by guest on 29 March 2024