



Conserving and Tapping Potato and Sweetpotato Crop Wild Relatives to Help Agriculture Adapt to Climate Change

CIP scientists have joined colleagues at other research institutions in efforts to improve the conservation and study of wild potato and sweetpotato relatives, and to tap their genetic diversity for improving cultivated potatoes and sweetpotatoes. The results, particularly in terms of understanding genetic diversity and suitable traits, could help feed the world as climate change makes it harder for smallholders in many areas to grow crops.



The research is part of a decade-long, global initiative called '[Adapting agriculture to climate change: collecting, protecting and preparing crop wild relatives](#)', which is funded by the government of Norway and coordinated by [The Global Crop Diversity Trust](#) with the [Royal Botanic Gardens, Kew](#). The project aims to strengthen the

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conservation of crop wild relatives (CWR) – wild plant species that are closely related to cultivated crops – and to help breeders tap their genetic diversity for the development of more resilient crop varieties.

“Crop wild relatives have evolved in their native habitats, coming to be adapted to specific conditions such as high temperatures, salinity, pests and diseases,” explained Nora Castañeda-Álvarez, a scientist at the International Center for Tropical Agriculture ([CIAT](#)), which CIP has partnered with on the CWR project and other initiatives. “Such traits can be bred into crop plants, greatly benefiting agricultural production, but this is only possible if these germplasm resources are made available to breeders.”

CIP has long been involved in the study and conservation of potato and sweetpotato CWR and the [CIP Genebank](#) preserves hundreds of CWR accessions, but its involvement in the global project has enhanced those efforts. The CWR project began with gap analyses for an array of crops to assess how well that biodiversity is conserved *ex situ* (in genebanks), and to identify species and areas in need of field collection. With support from the CGIAR Research Program for Roots, Tubers and Bananas (RTB), CIP researchers collaborated with scientists at CIAT, the U.S. Department of Agriculture, and universities in the Netherlands, the U.K. and the United States on gap analyses for potato and sweetpotato CWR, the results of which were published in 2015.

In the article “*Ex Situ* Conservation Priorities for the Wild Relatives of Potato (*Solanum* L. Section *Petota*),” [http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0122599#auth_contrib] published in PLOS ONE, the authors assigned 32 of the 73 closest potato wild relatives high priority status for further field collection, because they are under-represented in *ex situ* collections. They noted that there is an urgent need to collect samples of four CWR species that are completely absent from genebanks: *S. ayacuchense*, *S. olmosense*, and *S. salasianum* from Peru, and *S. neovavilovii* from Bolivia.

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Peru, which is one of the most important centers of potato diversity, has a large number of CWR species. But according to CIP consultant Alberto Salas, who has spent decades studying and collecting potato CWR, many of them are threatened in the field. He explained that the expansion of communities and road construction have destroyed the

habitat of rare CWR species, citing several species that have disappeared from areas where he once collected them.

Scientists from CIAT, CIP, USDA and several universities who collaborated on the sweetpotato CWR gap analysis encountered a comparable situation. They determined that 78.6% of the closest wild relatives of sweetpotato are high priorities for further collection. The researchers identified Central and Southern Mexico and the Southeastern United States as sweetpotato CWR biodiversity hotspots where collection should be prioritized.

“Unfortunately, it is in these ‘hotspots’ of great genetic diversity that the risk of losing it is particularly high,” said CIP associate scientist Bettina Heider. “The research on CWR has confirmed that not only do we have few sweetpotato CWR genetic resources in genebanks and herbariums, but the formal conservation of *in situ* resources (in the wild) is also very limited.”

Heider is one of 17 researchers who revised the taxonomic and geographic information on sweetpotato CWR, modeled their distributions, determined their availability to crop breeders, and explored their adaptations to climatic and soil stresses in order to identify species that could be useful for breeding more resilient sweetpotato varieties. The results of their research were published in the journal *Frontiers in Plant Science* under the title “Distributions, *ex situ* conservation priorities and genetic resource potential of crop wild relatives of sweetpotato [*Pomoea batatas* (L.) Lam., l. series *Batatas*],” (<http://journal.frontiersin.org/article/10.3389/fpls.2015.00251/abstract>)

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"We specifically looked for drought- and heat-tolerance, which are major issues in Sub-Saharan Africa and also increase vulnerability to major pest incidence in the region," said CIAT scientist Colin Khoury, the study's lead author, "We found that a number of these species, such as *Ipomoea littoralis*, *I. trifida*, *I. splendor-sylvae*, *I. leucantha*, *I. triloba*, and wild *I. batatas* were potentially distributed in regions with low precipitation and high heat, well beyond the comfortable range of cultivated sweetpotato."

Identifying CWR species with useful traits is an important step toward using them to improve crops, but genetic differences can make it difficult to cross wild species with their domesticated relatives. Such crosses often require a slow process of pre-breeding to make the CWR compatible with the crop species.

The global CWR project is supporting efforts to collect under-represented CWR species in the field and to develop pre-bred CWR materials with traits of importance for crops. In September 2015, Crop Trust scientist and CWR project manager Hannes Dempewolf traveled to Peru to see potato and sweetpotato CWR pre-breeding trials. He traveled to CIP research stations in Huancayo and San Ramón – in the Andes and Amazonian Highlands – where CIP is conducting CWR research.

While CIP has made progress toward introducing CWR resistance to the late blight and bacterial wilt diseases into its potato breeding lines, use of CWR species to improve sweetpotato is more incipient. With support from The Crop Trust, CIP is working with seven of the 14 CWR species in the *Ipomoea batatas* series *Batatas* to develop hybrids with useful traits such as drought- or heat-tolerance for use in sweetpotato improvement. "We are trying to get a mind change in breeding communities to think of wild relatives as an important source of genetic material to adapt crops to changing climatic conditions," Dempewolf said.

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CIP researchers hope that their work with CWR will contribute to breeding potato and sweetpotato varieties that produce well in harsh environments. This could be a boon for farmers in Africa and Asia as they struggle to produce enough food on an increasingly hot and crowded planet.

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