Samara

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Putting seeds to good use

Kyrgyzstan explores the pharmacological potential of its native flora

Landscape of Kyrgyzstan

Photo: RBG Kew

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Kyrgyzstan, despite its rather limited territory, has one of the richest floras in Central Asia, with around 4,000 species described to date, at least 10% of which are endemic or sub-endemic (i.e. grow only in Kyrgyzstan or slightly beyond its borders). The floristic diversity is partly due to Kyrgyzstan's geographic location in the heart of the mountain systems of Tian Shan and Pamir Alay, where the vegetation ranges from semi-desert to tall herb meadows and from fruit and nut forests to alpine pastures.

In 2005, work began on the *ex situ* conservation of Kyrgyzstan's plant genetic resources, led by the Institute of Biotechnology of the National Academy of Sciences of the Kyrgyz Republic (IB NAS), and supported by the MSB and the International Science and Technology Center (ISTC). The aim was to store plant genetic material in a national seed bank and in collections of *in vitro* tissue.

Preliminary phytochemical studies on the native flora identified over 180 species containing high levels of pharmacologically valuable compounds, and the in vitro collection focused on creating callus and root cultures of these for further study. One exciting result was the discovery that the endemic species, *Scutellaria andrachnoides* (skullcap) has a high content of wogonin, a promising anti-cancer agent, and two European Patent Society patents have now been

Royal Botanic Gardens Kew

MILLENNIUM SEED BANK PARTNERSHIP

A model of reforestation, food security and long-term carbon sequestration in Haiti

AVIRAM ROZIN (International Director, Sadhana Forest)

Since the earthquake in Haiti in 2010, there is growing awareness around the severe deforestation of the country. A few months after the earthquake, Sadhana Forest started its reforestation work in Anse-à-Pitres, southeastern Haiti. People there suffer from severe malnutrition so growing food could be a very strong incentive to plant and grow trees. A combination of fruits, nuts and edible leaves could dramatically improve the local nutritional status. Sadhana Forest's approach is to provide training in tree planting and care, harvesting produce, processing, cooking, and creating a healthy balanced diet. The trees are planted around homes to ensure they are watered and protected from animal grazing and cutting for charcoal production. Over the years we have refined our set of criteria for the choice of species. The trees to be planted should be indigenous, drought resistant, have a high wind resistance, since the area is frequented by hurricanes, produce food and preferably be oxalogenic, leading to a potential active oxalate carbonate pathway (OCP). Oxalogenic plants produce oxalic acid and transform it into calcium oxalate crystals within specialised cells called crystal idioblasts, ultimately utilising organic carbon, formed from atmospheric CO2 during photosynthesis. Calcium oxalate is insoluble and collects in nearby soils as the tree discards organic matter both above and below ground. This pool of calcium oxalate is then broken down by oxalotrophic bacteria present in the soil to form limestone (CaCO3), successfully sequestering CO2 within the geologic reservoir in the soil. Depending on climatic conditions, this carbon has a longer residence time within the soil compared to organically sequestered carbon. Thus, this long-term carbon sequestration is of particular importance given the ever-increasing emission of CO2 into the Earth's atmosphere.

***Genipa americana* seedling growing in the Sadhana Forest Haiti tree nursery.**

Our efforts to identify the appropriate species for reforestation led us to connect with the Millennium Seed Bank, RBG Kew and the seed bank of the Jardín Botánico Nacional Dr. Rafael M. Moscoso (JBN) in the Dominican Republic. The JBN did tremendous seed collecting work in Hispaniola funded by the Garfield Weston Global Tree Seed Bank Project among others. They have supplied us with a few interesting species that satisfied our basic criteria and two of them can potentially have an active OCP, including:

Sadhana Forest Haiti tree nursery.

Sadhana Forest Haiti team planting a tree.

Genipa americana L. - Cultivated for its edible fruit made into drinks, jams, and ice creams. The presence of oxalates has been confirmed in *Genipa americana* (Vasconcelos, et al., 2017) serving as strong evidence that the plant could have an active OCP in the right conditions.

Diospyros nigra (J.F.Gmel.) - A naturalised species in Haiti. Sweet, pudding-like fruits. It is safe to assume that it develops oxalate within its tissues, since calcium oxalate production has already been confirmed within the Diospyros family (Kumar, et al., 2011).

Hymenaea courbaril L. - Its hard pods have an edible pulp around the seeds. The sap is utilized in perfumes and varnishes.

The ongoing collaboration between RBG Kew and JBN is critical to the success of our land restoration model in Haiti. For further information please contact Aviram Rozin *(aviram@sadhanaforest.org)*.

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