

Factsheet final findings Applied Research Fund Call 1



Utilizing the genome of the vegetable species *Cleome gynandra* (spider plant) for the development of improved cultivars for the West and East African markets

Summary

Spider plant is a traditional leafy vegetable with a great potential for improving health and nutrition in Africa. The project aimed to develop high-yielding and nutrient-rich spider plant cultivars considering the expectations of farmers and consumers in Benin and Kenya. The project specifically addressed three research questions: 1-How can the diversity of spider plant be used to improve its yield and nutritional value?, 2-What are the best cultivation practices for the optimal and sustainable production of the species? and, 3-How can researchers and value chain stakeholders efficiently collaborate for successful impact of the breeding program? New local seed collections of accessions were established for Benin and Kenya. These were then used for genome-assisted breeding focusing on traits important to the growers and consumers of the species. Traditional knowledge related to the use and management of the species was documented in both countries and integrated into production and promotion strategies. Experiments were conducted to establish the best agricultural practices for the species and phenotypic and metabolomic characterization, thereby focusing on nutritional quality (especially related to vitamin A and E) and executed in controlled conditions. Spider plant genotypes were re-sequenced to facilitate molecular breeding strategies. New adapted cultivars with improved vitamin content will be created and technologies to grow and distribute them effectively will be developed to improve access to a healthy diet.

Research findings

- The species is easily self- and cross-pollinated which provided several options for cultivar development.
- Spider plant seeds are dormant and a germination protocol was developed.
- The best agronomic practices were developed, which improved the species cultivation and its introduction into urban and peri-urban market garden systems.
- The variability in nutrient content (e.g. vitamin C, pro-vitamin A, glucosinolates, flavonoids) and morphology in the species was assessed and is associated with the geographic origin of accessions.
- Genomic resources, including molecular markers and quantitative trait loci, were generated and will accelerate the development of nutritious and high yielding cultivars.
- Pests and diseases associated with the species were inventoried.
- A protocol for a systematic evaluation of spider plant's drought tolerance was developed in collaboration with farmers.
- One PhD student, seven MSc students and one BSc student were trained for a significant impact on capacity building for crop promotion.

Outcomes achieved

In Benin, spider plant was known by several rural communities as a medicinal and food plant. The Adja communities in the southern region of the country use to cultivate and sell the species in their local markets. However, in urban areas the species was less known. With the project, 20 farmers in urban and peri-urban areas started cultivating the spider plant and the demand in the species is increasing. In addition, it is now included in the diet of more than 200 urban households which are

part of the Community-Supported Agriculture system established by the NGO Hortitechs Développement and a network of farmers. Some local food enterprises including Agridynamic and Sahel Ltd. are interested in processing the leaves. There is a growing demand in spider plant in urban areas. More people are aware of the nutritional and medicinal qualities of the plant and integrate it into their eating habits.

Project messages to

A) Actors from private sector:

- The private sector needs to seize the business opportunities offered by neglected African crops. They have a lot to gain in investing in spider plant value chain development, given the many nutritive and medicinal properties of the plant.

B) Civil society and practitioners organizations:

- Civil society (users, consumers, farmers) must intervene at all stages of the selection process so that their preferential traits can be considered and the research results can be profitable to them.
- The research revealed several health benefits associated with spider plant consumption and farmers and consumers are invited to adopt the species. Moreover, civil society has an important role to play in disseminating the generated knowledge on spider plants.

C) Policy makers:

- African national policies must promote neglected African crops by providing financial and administrative facilities.
- The Ministry of Agriculture, and other institutions involved agricultural policy making in Benin and Africa in general, are invited to invest more in neglected crops with economic and nutritional potential.

Knowledge products

- [A roadmap for breeding orphan leafy vegetable species: a case study of *Gynandropsis gynandra* \(Cleomaceae\). *Horticulture research*, January 2018.](#)
- [Enhancing growth and leaf yield in *Gynandropsis gynandra* \(L.\) Briq. \(Cleomaceae\) using agronomic practices to accelerate crop domestication. *Scientia Horticulturae*, March 2018.](#)
- [Drivers of Management of Spider Plant \(*Gynandropsis gynandra*\) Across Different Socio-linguistic Groups in Benin and Togo. *Economic Botany*, August 2018.](#)
- [Andromonoecy in *Gynandropsis gynandra* \(L.\) Briq. \(Cleomaceae\) and effects on fruit and seed production. *Genetic Resources and Crop Evolution*, December 2018.](#)
- [Association between vitamin content, plant morphology and geographical origin in a worldwide collection of the orphan crop *Gynandropsis gynandra* \(Cleomaceae\). *Planta*, September 2019.](#)

Knowledge networks

The project was conducted by researchers from all consortium partners, as well as farmers and consumers in Benin and Kenya, respectively, collaborating with the NGO Hortitechs Développement and the Kenyan Resource Centre for Indigenous Knowledge (KENRIK). Project members at the Faculty of Agronomic Sciences of the University of Abomey-Calavi (FSA) and the African Orphan Crops Consortium (AOCC) contributed to setting up the African training and research mobility program MoBreed focused on African orphan crops breeding, with two MSc and two PhD students conducting their research on spider plant breeding. During the first African Plant Breeders Association Conference held in Accra (Ghana) from October 23th to 25th, 2019, a communication was made on the topic "Omics-assisted breeding for nutritional value in the orphan vegetable spider plant [*Gynandropsis gynandra* L. (Briq)]" Thereby, a poster on "Quantitative analysis of leaf yield and related traits in *Gynandropsis gynandra*" and "Germination and dormancy in seeds of five *Gynandropsis gynandra* genotypes and their crosses" was presented.

Knowledge co-creation

The project is based on a multi-stakeholders approach for knowledge generation and dissemination. End-users of developed spider plant cultivars including farmers, consumers and vendors were involved at the early stages of the project and actively participated to the definition of the product target (high-yielding and late flowering cultivars with regrowth capacity after cutting). During germplasm characterization, farmers and consumers were invited to assess the variability observed on-farm and re-define breeding objectives. At that step they also put emphasis on other criteria related to taste and odour of the leaves. Farmers are actively working for promotion of the species in urban and peri-urban vegetable production in Benin and Kenya. Results obtained from various research activities have been published. Other research projects are on-going, including quantitative analysis of leaf yield and related traits for speeding up improved cultivars development in multiple environments, and understanding quantitative traits underlying pigmentation and trichomes density in the species

Consortium Partners

- NGO Hortitechs Développement (Benin)
- [Faculty of Agronomic Sciences, University of Abomey-Calavi](#) (Benin)
- [Kenyan Centre for Indigenous Knowledge \(KENRIK\)](#) (Kenya)
- [Biosystematics Group, Wageningen University & Research](#) (Netherlands)
- [African Orphan Crops Consortium](#) (Kenya)
- [World Vegetable Center \(AVRDC\)](#) (Taiwan)

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Project website

[F&BKP Research Project page](#)