SP6: Variety development and seed systems

Project partners:

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I. Objectives

Overall aim of intervention

The overall aim of this subproject is to develop improved varieties and supply farmers with high-quality affordable seed of the three indigenous vegetables African nightshades (*Solanum* species), spiderplant (*Cleome gynandra*) and cowpea (*Vigna unguiculata*). Analyses on the genetic structure and diversity in the three crops as well as flower and seed biology build the scientific basis to reach this aim. The obtained knowledge will then be used to select varieties that better meet the actual demands of the farmers regarding tolerance to biotic and abiotic stress, productivity, nutritional and organoleptic value as well as postharvest quality. Besides, timely and sustainable seed availability, affordability and accessibility of the improved varieties are imperative. Thereby, this subproject being located upstream in the value chain may have beneficial and stimulating effects on all subprojects downstream.

Relevance of intervention to the objectives of the project

Contributions to value chain "Indigenous vegetables":

This project contributes to the description, evaluation and exploitation of the biodiversity of indigenous vegetables. It will set up profound and usable knowledge on seed production and factors determining seed quality. Furthermore varieties that are adapted to local variable climatic conditions will be developed. Thereby the outcome of this project will directly help to increase and ensure yield and profit as well as produce quality and nutritional value.

Contributions to value chain "Urban and peri-urban horticulture":

The outcomes of this subproject will assure quality in the upstream stages of this value chain and thus be fundamental for enhanced production and productivity. Most peri-urban vegetable farmers in East Africa still save their own seed, often from unmarketable plants or fruits, thus significantly reducing the crop quality of the next generation derived from such seed. Due to a combination of several limiting factors, most seed companies prefer to import seed from Europe and Asia rather than develop cultivars locally. To sustainably improve the productivity of the peri-urban vegetable sub-sector, it is essential that high quality seeds of superior, adapted varieties be developed and maintained, commercialized, and made available to farmers at affordable prices.

Within this project 4 PhD students will be educated in collaboration of the African and German partners. They should primarily come from African countries and will impart their knowledge to students, extension service and or farmers in their home countries during and after finishing their projects.

Research and/or technical goals of the intervention

The research goals of this intervention are given by the following four activities which will be described in detail in section III (workplan):

1. Analysis of genetic diversity of African nightshades, spiderplant and cowpea
2. Cytological and molecular studies of flowering and reproduction of African nightshades, spiderplant and cowpea
3. Variety development and improvement of African nightshades, spiderplant and cowpea
4. Seed harvesting, processing, storage and quality of African nightshades, spiderplant and cowpea

II. State of knowledge

African indigenous vegetables have been grown and utilized traditionally by many African communities and possess several advantages yet their potential has not been fully exploited due to constraints as e.g. the lack of quality seed (Schippers, 2000). The identified priority indigenous vegetables with nutrition and economic potential include cowpea, African nightshade, vegetable amaranths, spiderplant, pumpkin, slenderleaf, African kale, jute mallow and vine spinach (Abukutsa-Onyango, 2007a, Abukutsa-Onyango, 2003). In the target regions, vegetable production has been based on poorly adapted traditional varieties and seed for adapted cultivars is hardly available, accessible or affordable resulting in low and unstable yields (Hillocks, 2011).

Indigenous vegetables were grown as a subsistence crop and most farmers produced and saved their own seed from season to season and sell surplus to other growers. Quality of such seeds was poor in terms of purity, viability and seed dormancy issues. There is need for production and supply of quality seed to increase yields, productivity and quantities produced to meet the unsatisfied markets of these vegetables especially in urban centers. Seed harvesting, processing, storage and packaging is very important for seed quality and for optimal seed production. Seed dormancy and photo inhibition of germination have been observed in nightshade and spiderplant respectively and these need to be investigated further.

Several initiatives have tackled the lack of improved locally adapted varieties and insufficient seed supply, such as vBSS (vegetable breeding and seed systems), the Good Seed Initiative (Phiri, 2006; AVRDC, 2011), the Kenyan Sustainable Agriculture Community Development Program that initiated seed packing methods, and training efforts of the Rockefeller Foundation to improve breeding capacity in the region. With funding from GIZ-BMZ between 2003-2009, AVRDC collected, characterized, evaluated and purified several indigenous vegetable varieties of crops such as amaranth, okra, African eggplant, spiderplant, African nightshade, vegetable cowpea, Ethiopian mustard, and jute mallow (AVRDC, 2006; 2010). With further support from Bill and Melinda Gates Foundation between 2007-2010, several tomato and indigenous vegetable varieties were released and farmer's access to seeds was improved (AVRDC, 2011). Germplasm collection, evaluation, characterization and multiplication of African nightshade and spiderplant have also been carried out in Kenya. The participatory selected priority ones were multiplied, evaluated, processed and packaged for a test run of seed distribution (Abukutsa-Onyango, 2007b).

In spite of these variety development efforts, there is still insufficient supply of locally adapted varieties and bred improved varieties are not available at all for many indigenous vegetable species. Insufficient characterization of indigenous vegetables at morphological and molecular level causes severe limitations for genebank curators and breeders (Ngwendiagi et al., 2009). Molecular characterization of the target indigenous vegetables would contribute to biodiversity maintenance efforts, facilitate parental selection in breeding, and allow for marker-trait associations, paving the path for molecular breeding of the vegetables.

AVRDC has been carrying out successful pilot interventions on improving seed supply of indigenous vegetables through strong partnerships with seed companies in East, Central and Southern Africa. AVRDC improved varieties have been distributed to the partner seed companies who carry out joint multi-locational evaluation trials, participatory selection, promotion activities, release of varieties, multiplication of seed of selected varieties and commercialization. Part of the seed production for the companies is carried out by contract farmers. This intervention has been very successful with improved tomato lines. However, only a few varieties of indigenous vegetables have been released and are being commercialized by a few seed companies in Kenya, Tanzania and Uganda. An important step would be to have the seed certified by regulatory authorities for quality aspects, and this is only possible if the varieties are officially released.

III. Utilization of results (Uptake)

Adoption of the developed technologies will be ensured through involvement of all actors and addressing all bottlenecks along the vegetable production chain to maximize the translation of the research outputs into developmental outcomes. The mid-term utilization of results will focus on improved strategies to produce seed based on genetic information (improving the structure of gene pools, utilization of optimized germplasm) and improved parameters for harvesting and storage of seeds (optimized harvest time, storage and seed germination conditions). These results will mainly be communicated through academically trained extension staff, academic researchers and by communication of the results to seed producing organisations. Long-term utilization will be through providing improved varieties and seed harvesting strategies and through and additional targeting of farmer communities in poor regions, where malnutrition is prevalent, and through its gender-sensitive approaches, so that it will be ensured that the most food insecure population will benefit from this project.

IV. Internal division of labour/Cooperation with other subprojects/cooperation with third parties

Each of the four activities listed above will be coordinated by one of the partners of the subproject but conducted in close collaboration among all partners. For example markers developed by Thomas Debener will be utilized in breeding schemes of Fekadu Dinssa and for flowering time analyses conducted in the lab of Traud Winkelmann. Ploidy information generated by Traud Winkelmann will be used in the breeding and selection schemes of Fekadu Dinssa. The three species under investigation will be analyzed for a range of phenotypic characteristics. As other subprojects will work on the same crops it is intended to create as much overlap as possible in the genetic materials used so that for example information about postharvest parameters (Sub project “Quality assurance and preservation of African vegetables during postharvest for reducing food losses and improving nutritional value, storability and food safety: Heiko Mibus) and glucosinolate compositions (same sub project as before: Monika Schreiner) in spiderplant or drought tolerance (Sub project “Increasing water use efficiency in indigenous vegetable production systems”: Hartmut Stützel) as well as information about resistance to pathogens and pests (sub project “development of integrated pest management strategies for the production of important vegetable crops in Kenya”) will be provided by other sub projects. Furthermore for spiderplant it is planned to cooperate with a Dutch consortium that intends to genotype by sequencing a larger number of *Cleome* genotypes.

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