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Short Communication

Connecting genebanks to farmers in East Africa through the distribution of vegetable seed kits

Tsvetelina Stoilova[1], Maarten van Zonneveld[2]*, Ralph Roothaert[1] and Pepijn Schreinemachers[3]

[1]*World Vegetable Center, Eastern and Southern Africa, Duluti, P.O. Box 10 Arusha, Tanzania,* [2]*Genetic Resources and Seed Unit, World Vegetable Center, P.O. Box 42 Shanhua, Tainan 74199, Taiwan and* [3]*World Vegetable Center, East and Southeast Asia, P.O. Box 1010 (Kasetsart), Bangkok 10903, Thailand*

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Abstract

Genebanks explore new partnerships with farmers and other user groups to provide smallholder farmers in Africa better access to crop diversity for improved nutrition, climate change adaptation and agricultural diversification. This paper shows how the World Vegetable Center (WorldVeg) genebank of traditional African vegetables and its partners distributed over 42,000 seed kits containing over 183,000 vegetable seed samples from 2013 to 2017 to smallholder farmers in Tanzania, Kenya and Uganda. The seed kits contained seed samples of promising accessions and open-pollinated breeding lines of traditional African vegetables, and to a lower degree of tomato, *Capsicum* pepper and soybean, usually enough to plant in a home garden. We identified four research questions to better understand the role of vegetable seed kits in strengthening local seed systems, impact on local vegetable diversity, improving human nutrition and supporting climate-resilient agriculture. As formal seed systems expand their reach, the genebank's role to supply vegetable diversity to public and private breeding programmes becomes more important. To optimize supply of vegetable diversity, the WorldVeg genebank of traditional African vegetables continues working with partners in both formal and local seed systems.

Keywords: *ex situ* conservation, germplasm distribution, home gardens, neglected and underutilized species, seed supply, seed systems, traditional African vegetables

Introduction

Genebanks traditionally supply crop diversity to support plant breeding in formal seed systems comprising of agricultural research organizations and seed companies. In Africa, however, formal seed systems are weak and smallholder farmers get more than 80% of their seeds from local seed systems (Louwaars and De Boef, 2012; McGuire and Sperling, 2016). To enhance utilization of crop diversity in Africa, genebanks have started to experiment collaborating directly with farmer groups in *on-farm* evaluation for direct use (Westengen *et al.*, 2018).

This paper provides the example of the World Vegetable Center (WorldVeg) genebank of traditional African vegetables. This genebank has distributed over 42,514 seed kits with a total of 183,193 seed samples to smallholder farmers in Tanzania, Kenya and Uganda between 2013 and 2017 (Fig. 1; Table 1; online Supplementary Table S1).

*Corresponding author. E-mail: maarten.vanzonneveld@worldveg.org

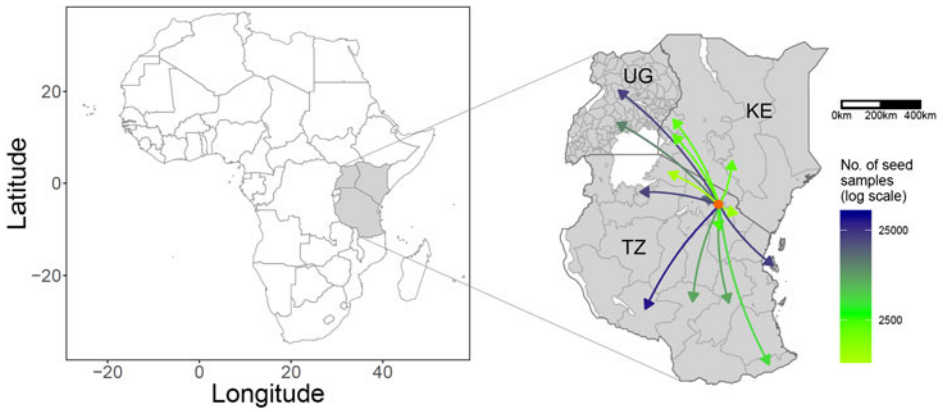

Fig. 1. Distribution of seed samples to farmers in Tanzania (TZ), Kenya (KE) and Uganda (UG) in East Africa. The orange spot is the location of the WorldVeg genebank of traditional African vegetables in Arusha, Tanzania.

Table 1. Distribution of seed samples per species and country

Vegetables species of which seed samples were distributed		Number of seed samples distributed per country			
Scientific name	Crop name	Tanzania	Uganda	Kenya	Total
Amaranthus cruentus	Amaranth	26,541	8000	1000	35,541
Solanum scabrum	African nightshade	22,007		1000	23,007
Solanum aethiopicum	African eggplant	19,358	2890		22,248
Vigna unguiculata	Vegetable cowpea	15,736	3070	1500	20,306
Brassica carinata	Ethiopian mustard	13,894	520		14,414
Abelmoschus esculentus	Okra	10,806	1900	500	13,206
Cleome gynandra	Spider plant	5999	3320	1000	10,319
Corchorus olitorius	Jute mallow	9575			9575
Solanum lycopersicum	Tomato	5826	1440		7266
Cucurbita moschata	Pumpkin	4110	1900	500	6510
Amaranthus dubius	Amaranth	5390	120		5510
Amaranthus tricolor	Amaranth		4530		4530
Glycine max	Soy bean	4240			4240
Solanum spp.	African eggplant	2400	120		2520
Solanum anguivi	African eggplant		1840		1840
Solanum villosum	African nightshade	943			943
Amaranthus hypochondriacus	Amaranth	58	520		578
Crotalaria brevidens	Sun hemp	10		500	510
Capsicum annuum	Chile pepper	120			120
Moringa oleifera	Moringa	10			10
Total number of seed samples		147,023	30,170	6000	183,193

The seed kits that farmers received contained on average four seed samples of different vegetable crops or varieties, usually enough to plant in a home garden (online Supplementary Fig. S1). Seed kits included lines of traditional African vegetables, WorldVeg tomato lines and in some cases *Capsicum* pepper and soybean lines (Table 1). The full dataset is available at https://www.gbif.org/dataset/b5d15a8b-0500-4d8b-b156-9da14da494cc. Thirty-two per cent of the seed distributed came from promising accessions and 68% from breeding lines; all are maintained by the WorldVeg genebank.

The WorldVeg genebank of traditional African vegetables

The genebank currently has 2500 accessions of mostly traditional African vegetables, and conserves, screens and distributes this germplasm. The collection originated from germplasm-collecting missions with national partners across Africa, mostly in the early 2000s. Other accessions came from the WorldVeg genebank in Taiwan.

Seed kit distribution

The WorldVeg genebank of traditional African vegetables has distributed seed kits in East Africa since the early 2000s, systematic recording started in 2013. The following facts are important about the seed distribution:

First, accessions and breeding lines selected for the vegetable seed kits were tested under local conditions for yield, disease resistance and consumer preference.

Second, distributed lines were open-pollinated so that farmers could save seed.

Third, seed was distributed through international NGOs, farmer groups, local governments and WorldVeg projects (online Supplementary Table S2). Seed kit distribution was not intended as emergency seed aid, but was part of home garden projects aimed at improving nutrition and diversifying incomes.

Fourth, seed kits were distributed in combination with capacity development in vegetable growing and seed saving. Seed kits contained instructions of good agricultural practices and the nutritional values of the concerning crops. WorldVeg collects feedback from farmers about the seed kits supplied in certain projects but not all. Some impact studies on home garden interventions have been published (e.g. Schreinemachers *et al.*, 2018).

Fifth, these were one-time distributions of seed kits, so households did not receive a regular supply of seed that might create dependency or crowd-out local seed enterprises (McGuire and Sperling, 2016).

Discussion

Our seed kit example shows how new partnerships between genebanks and public, private and societal partners allow to supply many smallholder farmers with crop genetic diversity. We identified four research questions to better understand the role and impact of seed kit distribution on seed systems, local vegetable diversity, nutrition and production.

First, what is the role of seed kit distribution in strengthening local seed systems of vegetables? Seed exchange between recipients of seed kits and non-recipients can multiply the effect of seed kits and contribute to large-scale diversification of seed supply (Coomes *et al.*, 2015). Tracing seeds and mapping seed networks will provide a better understanding of the effectiveness of seed kit distribution to strengthen local seed systems. Collaboration with farmer groups and national agricultural institutions ensures that further steps in seed system development, breeding and seed production are in line with farmer interests and national seed policies.

Second, what is the impact of seed kit distribution on local vegetable diversity? While replacement of existing landraces could lead to genetic erosion, introduction of new germplasm may enhance levels of local vegetable diversity.

Third, how many people improve their nutrition after seed kit distribution and strengthened seed systems? Seed kit and home garden interventions effectively help poor rural households to improve their nutrition, generate income and enhance gender equality within households (Berti *et al.*, 2004; Schreinemachers *et al.*, 2016). It is less clear how seed kits can foster nutritional outcomes at the level of communities and food systems.

Finally, how does farmers' use of seed kits help adapt farming systems to the negative effects of global climate change? Vegetable seed kits may introduce new crops and new varieties adapted to changing climates and with potential to diversify farming systems for income and yield stability under climate change (van Etten *et al.*, 2016). Seed kit distribution with climate-resilient vegetables for *on-farm* evaluation combined with remote sensing of changes in farmers' crop portfolio can help to understand the effectiveness of seed kits to promote variety and crop adoption.

Currently, seed kit development and distribution is financed by development projects. The production of a vegetable seed kit with four seed samples costs about US $5 to produce, excluding distribution costs. To make seed kits more attractive, the production costs can be decreased by focusing on fewer crops or by working with local seed companies that have specialized capacity to produce seed kits. WorldVeg has recently started to charge up to 10% of the cost price of seed kits to farmers to increase farmers' contribution in future, considering that farmers in African countries are willing to invest in seed (McGuire and Sperling, 2016). This paves the way for commercialization of seed kits by local seed companies.

As formal seed systems expand their reach, the genebank's role to supply vegetable diversity to public and private breeding programmes becomes more important. This trend takes place in Kenya, Tanzania and Uganda where seed companies have started to sell seeds of traditional African vegetables. To optimize supply of vegetable diversity, the WorldVeg genebank of traditional African vegetables continues working with partners in both formal and local seed systems.

Supplementary material

The supplementary material for this article can be found at https://doi.org/10.1017/S1479262119000017

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