Plan for Improving Seed Potato in Georgia – September 2018

Introduction

Potato is an important crop in Georgia, with approximately 25,000 ha under production, and annual per capita consumption of almost 55 kg (Geostat). Nearly all potato is consumed fresh, and Georgians consider the crop as their “second bread.” Despite potato’s importance in the diet and culture, yields remain low: at roughly 12 t/ha, the national average is far below yields of 40 t/ha or more found in many Northern European countries. Research has demonstrated that with current varieties, attainable yields (on experiment stations and by best high-input farmers) are 25–30 t/ha (Carli et al., 2010; Mdivani, 2012). The proposed Seed Plan will contribute to reduce this large gap between actual and attainable yields.

Tubers serve as the planting material, or seed, of the potato. The poor quality of seed potato is one of the main causes of the low productivity and reduced profitability of Georgia’s potato crop (Carli et al., 2010; MoA 2015). As a vegetatively propagated crop, seed potato accumulates pests and pathogens—particularly viruses—over successive seasons of cultivation. This leads to a reduction in yield capacity and/or quality of the product, a phenomenon referred to as *potato seed degeneration* (PSD) (Thomas-Sharma et al., 2015). In response to the problem of PSD, seed certification systems in the United States and Europe were developed in the early part of the 20th century (Frost et al., 2013). These systems have been highly successful, making high-quality seed readily available to farmers and virtually eliminating PSD in high-income countries. Many efforts to establish certified seed systems for potato in low-income economies, however, have had little success, and most potato farmers in these areas source seed from the informal seed system (e.g., produced on-farm, acquired from neighbors or local markets) (McGuire and Sperling, 2016). Such seed can often be highly degenerated and cause major reductions in productivity (Thomas-Sharma et al., 2015).

Currently, most potato seed in Georgia is self-saved (as part of ware production), or gotten from local sources, by small-scale farmers who are unaware of practices to maintain seed quality (e.g., proper storage). Most of this seed is severely affected by PSD (MoA 2015). Even the portion of seed that is imported and has been multiplied in country, is sold without certification or proper bagging and labeling. Farmers routinely do not use on-farm practices aimed at maintaining seed quality, seed treatment, and seed selection. Nor have they had systematic, formal access to training that would enable them to properly manage their potato harvests (Carli et al., 2010). Direct access to imported seed is limited in Georgia, and such seed is very expensive due to the high relative value of the Euro currency. Seed multiplied from imported seed costs 2–3 GEL/kg, whereas seed from local sources costs 0.5–0.8 GEL/kg. That the quality of imported seed is not guaranteed is another issue; for example, seed quality is sometimes greatly diminished by poor transport conditions. In addition, seed imported from Europe is of varieties that generally lack resistance to pathogens causing PSD, principally the two most yield-reducing viruses, potato virus Y (PVY) and potato leafroll virus (PLRV). We are unaware of studies demonstrating the susceptibility of potato varieties currently imported into Georgia, but many of the same ones were found to be highly susceptible in recent studies done in Tajikistan (CIP 2016). All these factors have caused the majority of the seed potato planted in Georgia to be highly affected by PSD (MOA 2015).

Georgia has excellent agronomic and environmental conditions in highland areas where high-quality seed can easily be produced (Carli et al., 2010). During the Soviet era, however, both seed production and seed certification management were centralized in the Soviet Union and basic seed was produced in Russia, Belarus, and Ukraine. This seed was then shipped to other Soviet countries, including Georgia, for further multiplication and eventual certification. Thus, a full seed production chain did not exist in Georgia at that time. With the collapse of the Soviet Union, the flow of basic seed and support for certification stopped, effectively ending certified seed production in Georgia. Subsequently, some high-quality seed has been imported from Europe, but in small amounts; even after multiplication in Georgia it represented less than 10% of seed needs (GeoStat). There is currently no control on the quality of imported seed.

Objectives and approach

The objective of this plan is to provide direction to appropriate Georgian authorities for addressing constraints related to the quality seed production in Georgia, especially PSD, in the next five years. This plan is based in the *Integrated Seed Health* (ISH) approach which describes three tactics to manage PSD (Thomas-Sharma et al. 2015): (1) the adoption of varieties that degenerate slowly due to their natural resistance to the organisms that cause PSD; (2) on-farm practices to maintain or even improve seed quality; and (3) a more strategic use of certified seed (i.e., buying in small amounts or less frequently, depending on the other components of ISH). Each of these tactics corresponds to a component in the current Seed Plan.

Important. This Seed Plan should be closely linked to a plan to develop the ***potato value chain*** in Georgia. This is because potato yields are expected to increase as result of the activities implemented in the Seed Plan, and this surplus must be taken up by increased local consumption, or international markets. If not, potato prices could collapse, and potato farmers' economies would be damaged.

Beneficiaries

The target beneficiaries of the activities implemented as part of the Seed Plan are potato farmers in Georgia, who will improve the quality of planting material, boost their productivity and yield stability, and consequently, increase their families' income and quality of life. Increased profitability of the potato crop could also benefit consumers through lower and/or more stable prices. An improved seed system will lead to more efficient diffusion of new varieties, which has benefits to farmers and consumers that transcend productivity.

Potential benefits

Although it is difficult to quantitatively predict the benefits to the target group, previous experiences of the International Potato Center (CIP) would indicate that very significant increases in productivity can be expected by improving seed quality. For example, researchers in Sub-Saharan Africa (SSA) have shown yield increases of ~30% on average with one season of positive selection (PS) (Schulte-Geldermann et al., 2012). PS is not 100% efficient—farmers might miss latently or even mildly infected plants—so some yield loss would still occur. Presumably, these studies present a highly conservative estimate of actual yield losses in farmers' fields caused by degeneration. As well, raising awareness of how to properly manage potato fields would facilitate the adoption of good agronomic practices, further increasing current potato yields in Georgia. There is also strong evidence that host resistance to PSD pathogens benefits farmers. Several seed degeneration studies have compared two or more varieties, sometimes with known levels of resistance, and indicated differences in yield loss. In Kenya for example, after four seasons the overall yield reduction in genotypes resistant to multiple viruses ranged from 5% to 33%, whereas yield reduction in the local Ugandan and Kenyan varieties ranged from 56% to 58% (Ondity et al., 2013).

Governance

The implementation of the Seed Plan will be led the Ministry of Agriculture. A multi-stakeholder platform (see example in Thiele et al. 2011), or *Seed Potato Platform (SPP)*, will be created to support the implementation of the Plan. The SPP will include stakeholders related directly to seed production, distribution and use, such as national R&D organizations[1], farmers' cooperatives, seed importers, seed producers, donors, international R&D organizations (CIP, FAO), etc. The SPP should be part of a wider platform to develop the potato value chain in Georgia, which will include the above stakeholders, plus other related to markets and consumption, such as processors, supermarkets, consumers' associations, etc.

Funding

The design of this Plan is supported by the project *Enhancing Rural Livelihoods in Georgia: Introducing Integrated Seed Health Approaches to Local Potato Seed Systems* funded by the Austrian Development Agency (ADA) (CIP 2018). Likewise, several activities described below are currently being funded and implemented by this project. The MoA and other partners are expected to fund significant portions of this Plan.

Resources

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1 Ministry of Agriculture (MoA); Scientific Research Center of Agriculture (SRCA); MoA–Farmers' Extension Service Centers (FESC); MoA–Grain Logistic Company (GLC)

CIP is working closely with the MoA and other partners to provide support on the design and implementation of this Plan. A comprehensive set of bibliographical resources, including research papers, training materials, Web sites, etc., is accessible through the internet (see References).

Components and activities

Below, the details of the plan are provided by the three components of *Integrated Seed Health*. Each component has several activities and for each we describe the methodology, the expected outputs and timeframe, ongoing activities implemented by the ADA-funded project, and action plan (to be developed during the start-up workshop) (Excel document, attached).

Component 1: Adoption of varieties that degenerate slowly due to their natural resistance to the organisms that cause PSD

The activities in this component are aimed at improving the adoption of varieties resistant to viruses, the main cause of PSD in Georgia and elsewhere. However, these varieties must be developed first, because there is indirect evidence (Forbes et al., 2018) that shows that most of the varieties grown in Georgia are susceptible to viruses. In addition, virus resistance is just one of the traits considered when developing a new variety. Therefore, this component includes activities that are part of a variety development program, but that can be included in the current Seed Plan (to be discussed during the start-up workshop).

Activity 1.1. Import new genotypes from CIP and other sources. Potato experts (scientists, extension agents, processors, and farmers), in coordination with breeders from CIP and other organizations, will select potato genotypes from existing catalogues (e.g., CIP n.d.), as part of a variety development program. The expected output is 20 to 25 new potato genotypes available in Georgia every two or three years.

Activity 1.2. Identify and catalogue virus resistance in candidate varieties. Between 20 and 25 potato genotypes will be planted in areas and seasons with high aphid populations and virus incidence to evaluate resistance to main viruses (PVY and PLRV) following the protocol developed by CIP (CIP 2016, pg. 75). Evaluation to other biotic and abiotic constraints could also be included. The expected output is a catalogue of potato genotypes characterized by their resistance to virus. In addition, the methodology for testing virus resistance is expected to be up taken by Georgian breeders to be implemented in a variety development program. Currently, the ADA-funded project is finishing the first cycle of evaluations of 32 potato genotypes.

Activity 1.3. Participatory varietal trials. Between 20 and 25 potato genotypes will be selected under field conditions by farmers, consumers, scientists, etc. following a participatory methodology (De Haan et al., 2017) for 3 years, paying close attention to gender considerations (Mudege et al., 2017). The expected output is 2 to 5 potato genotypes identified for local conditions every 2 or 3 years, as part of a variety development program.

Activity 1.4. Release and dissemination of new varieties. Potato genotypes will be launched formally by Georgian authorities following protocols developed in Component 3, as part of a variety development program. Dissemination of new varieties will include the production of certified seed (also addressed in Component 3) and distribution to farmers using several mechanisms, e.g., vouchers (Ogero et al., 2016, pg. 80), small seed packs (FIPS n.d.), etc. The expected output is 2 to 5 new potato varieties launched officially and in hands of at least 5000 farmers at the end of five 5 of this Plan.

Activity 1.5. Adoption studies of new varieties. Expert elicitation workshops will be used to monitor the degree of adoption of new varieties (see an example in Gatto et al., 2017), as part of a variety development program. The expected output is a study to identify the varieties with the highest adoption every 5 to 7 years.

Component 2: On-farm practices to maintain or even improve seed quality

The activities in this component are aimed at improving farmers' capacities to manage their seed potato in the field, but these can also apply to seed multipliers. This component will be particularly important in the Southern Highlands and the Northern Highlands where an estimated 70% and 20% of seed, respectively, come from farmer-saved tubers (Forbes et al., 2018). It will also be important in the Midlands region to improve current use of seed imported from Europe by using seed replacement practices that combine the use of high quality seed (component 3) with on-farm practices. This component includes activities for adapting technologies and training materials to Georgian conditions, training extension agents and farmers, and monitoring progress on seed health.

Activity 2.1. Adaptation of techniques and training materials. Previously developed techniques and training materials on positive selection (Gildemacher et al., 2007a and 2007b), seed plot technique (Bryan 1983; Kinyua et al., 2015), replacement practices with certified seed (Obura et al., 2016), and techniques for managing seed-borne pests (e.g., late blight, Caceres et al., 2008) will be adapted to Georgian conditions by experts and validated with farmers. Training resources will include not only printed materials, but also videos (see cassava example, Access Agriculture n.d.), etc. The expected output is a set of techniques and training materials for improving farmer-saved seed adapted for Georgian conditions available in the next 2 years and then updated every 5 years. Currently, the ADA-funded project has adapted training materials for positive selection.

Activity 2.2. Training of extension agents and farmers. Training of trainers' courses using previously developed materials (Gildemacher et al., 2007c) will be conducted to improve the capacities of extension agents to reach farmers and help them to manage their seed, using the techniques mentioned above. Methodologies to improve farmers capacities will include farmers' field schools (e.g., Wahyuning et al., 2006), and others depending on the context. The intended output is to have xx extension agents and xx farmers trained on management practices for improving farmer-saved seed every year (the first promotion graduated after 2 years). Currently, the ADA-funded project has started training farmers on the positive selection technique.

Activity 2.3. Monitoring seed health. Although the baseline study provided valuable information on major seed-borne diseases (Forbes et al., 2018), it is important to identify new seed-borne pests and diseases and monitor the progress of seed health as result of the introduction of new varieties and capacity development activities described above. Seed tubers from a randomly selected sample of farmers will be collected and analyzed using ELISA tests or other diagnostic techniques. The expected output is a map with incidence and severity of major seed-borne potato pests and diseases updated every 2 years. Currently, the ADA-funded project, using expert elicitation, has identified several seed-borne diseases, including potato wart, a quarantine disease caused by *Synchytrium endobioticum* (Forbes et al., 2018).

Component 3: Strategic use of certified seed

This component will promote the production of certified seed in Georgia (i.e., to develop the formal seed sector) and improve its use by implementing seed replacement practices that combine the use of high quality seed and on-farm practices (Component 2). The activities will follow the *participatory market chain approach* (PMCA, Bernet et al., 2006), and should be closely linked to activities aimed at developing the potato value chain in Georgia. In the PMCA, stakeholders of the Seed Potato Platform (SPP) will interact to identify market opportunities and then develop innovations to take advantage of them. Innovations are categorized into 3 classes: commercial innovations (e.g., a new commercial product); technological innovations (e.g., a new agronomic technique); and institutional innovations (e.g., a new regulation, a new farmers' cooperative). The PMCA includes three phases: (1) market chain survey; (2) analysis to develop joint business opportunities; and (3) implementation of joint innovations. Each of these phases corresponds to an activity in Component 3, which will be defined in detail by the stakeholders, during the PMCA.

Activity 3.1. Market chain survey. The R&D organization leading the PMCA will conduct 20 to 40 interviews to identify key stakeholders and explore market opportunities and bottlenecks. The results will be presented in a public event where stakeholders will start interacting. The intended output is a report indicating key stakeholders, market opportunities and bottlenecks. Examples of market opportunities include: a processing company that operates under a contract farming approach and needs to provide high-quality seed to its associated farmers; a demand of certified seed from a neighboring country, etc. Examples of bottlenecks include lack of a technique for producing high-quality seed or for identifying key seed-borne pathogens; lack of a network of seed producers; lack of a regulation to export seed; etc. This activity will take 3 months approximately.

Activity 3.2. Analysis to develop joint business opportunities. After market opportunities and bottlenecks are identified, the stakeholders, organized in thematic groups, will analyze them and develop work plans. For example:

- One thematic group could develop work plans (business plans in this case) for commercial innovations, such as a new brand of certified seed produced and distributed by a farmers' cooperative or a local company.
- Another thematic group could develop work plans to develop technical innovations, such as improved techniques to produce *in vitro* plants, minitubers or cuttings; a new diagnostic technique to detect seed-borne diseases; a seed replacement practice to combine the use of high quality seed and on-farm practices, etc.
- Another group could develop work plans to develop institutional innovations, such as creating a new regulation for exporting seed to neighboring countries, or for producing quality declared seed; or promoting the creation of a new network of seed multipliers, etc.

The workplans will be presented in a second public event. The intended output is a work plan for each thematic group. This activity will also take 3 months approximately.

Activity 3.3. Implementation of joint innovations. The final activity is to start the implementation of the work plan by each of the thematic groups. They can request support to conduct specific studies or tasks, for example:

- A business plan for the production and distributions of certified seed by a farmers' cooperative or a local company.
- Experiments to adapt technologies to improve the production of *in vitro* plants, minitubers or cuttings.
- Experiments to adapt a diagnostic technique to local conditions.
- Experiments to test seed replacement strategies.
- A regulation for exporting seed.
- A regulation for producing quality declared seed.

Consulting firms and experts could be hired to conduct these studies and tasks. The resulting innovations (e.g., a new brand of certified seed, a new seed regulation, a new technique for producing *in vitro* plants, etc.) will be presented in a final public event. This activity will also take 6 months approximately, and follow-up of these activities could take 2 to 5 years, depending on the innovation.

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