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Research Article

DEVELOPMENT OF ELITE SEED PRODUCTION TECHNOLOGY FROM *IN VITO* POTATO IN GEORGIA

MEGRELISHVILI IVETA*, KUKHALEISHVILI MAIA, BULAURI EKATERINE, SHAMATAVA TAMAR AND CHIPASHVILI TAMAR

Georgian Technical University, Biotechnology Center, Tbilisi, 0175, Georgia
*Corresponding Author: Email-ivetameg@yahoo.com

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Abstract- Potato (Solamum Tuberosum L.) is one of the most popular crop in Georgia. The climatic conditions of Georgia enable us to produce several varieties of potato cultivars. The research goal was the development of seed production methods from apical meristem in order to get super elite seed. Three potato varieties were selected for the experiment: "Sante", "Amoroza" and "Nevsky". It is the first time that potato super elite seed was produced from strengthened *in vitro* plants (in the laboratory condition –instead of greenhouse) in Georgian regions: Akhaltsikhe and Tsalka. It was releaved that potato cultivar Nevsky characterized high elite seed Production ability (5ton), Sante showed relatively low Harvest (2ton) in Tsalka, other results were the same among Georgian two regions Akhaltsikhe and Tsalka.In this way, World-renowned elite seed making full cycle modification was performed in the conditions of Georgia: laboratory-greenhouse-open field was replaced by laboratory-laboratory (plants strengthen)-open field. .

Keywords- Potato varieties, developed method, elite seed, *in vitro*, technology, production

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Introduction

Potato is the most widespread culture, in terms of consumption potato is in the second place after cereals [1]. Wide flexibility in planting and harvesting time are potato's valuable characteristics that help adjusting this crop in various environmental condition [2]. The Production of good quality seed has been recognized the most important factor in the developing countries. The production of virus free plants using meristem-tip culture starting in the 1950's and continuous up to data. Meristem culture was possibly the first biotechnological approach used to eliminate viruses from systemically infected potato cultivars [3-6]. Over the years, this technique has been successfully combined with micro propagation to produce disease-free potato seed [7, 8]. Optimization of commercial production of disease/virus-free propagules in the seed potato system encompasses various aspects of micro propagation technology. These include improvements in mass multiplication phase, storage of cultures and the usage of micro tubers in the system. Micro tubers of the Russet varieties can be successfully used to speed up the multiplication in the seed potato system, in the greenhouse production of mini tubers [9]. The National Centre for Seeds and Seedlings (NCSS) is introducing a new method of producing mini tubers (MnTs) by using hydroponic cultivation greenhouse to increase the efficiency of propagation and rapidly disseminate these new potato varieties [10].

Nowadays Georgia has no potato seed production system (or company) as Climate of mountain region allows us to produce potato cultivars. Healthy seed is the guarantee of quality seed materials. Expensive, certified, commercial seeds are imported on the market of Georgia, but most farmers do not have access on them, on the other hand, this material usually has pests and diseases which accumulate from one cycle to another. Virus infected potato planting material located inside the country and crop has a low yield. Mentioned above it is clear that progressive technologies are necessary in the potato seed production technology and it is reflected in the development of biotechnologicat methods. In this regard potatoes seed production is transferred to a virus-free basis in the world and use with effective, apical meristems method now [11, 12].

The research goal was to develop intensive technology of receiving virus free super elite seed of potato cultivars on the base of acceptance-strengthen *in vitro* tube plants in semi-open field condition (without greenhouse). The selected potato species are introduced from abroad and are more or less adapted for environmental conditions in Georgia.

Materials and Methods

Samples were collected from *in vitro* potato collection of Georgian Technical University, Biotechnology Centre. For *in vitro* potato propagation we use basal MS medium [13] the pH of the medium was adjusting 5.8, agar (7g/l) was added into the medium and the medium was autoclaved at 121^{0}C for 20 minutes at 15 psi. MS basal medium containing 30 g/l sucrose, 1g/l 6-benzylaminopurine (BAP), 0.01mg/l, Indole-3-acetic acid (IAA). All the surface sterilization procedures were carried out under sterile condition of laminar flow chamber, 4-week-old explant were dissected into single nodes (2-3 cm long) on a sterile plate. The excised explants were cultured into culture medium in tube and incubated under 16-hour photoperiod at 25-26^{0}C with a light intensity of 2500 lux. The sprouts were allowed to grow into plantlets having nodal segments for 3 to 4 weeks. *In vitro* plant with 4-5 nods were placed into plastic vessel contained soil and put in Laboratory for strength and adapted soil condition. Strengthen plants were planted in open field.

Potato cultivars were tested by double antibody sandwich-ELISA (DAS-ELISA) as reported by Clark and Adams [14] for PVX, PVY, PVA, PLRV, PVM, PVS using commercial kits from BIOREBA AG (Switzerland) according to the manufacturer's Instructions: leaves were crushed ((w/v) 1:5) in extraction buffer (pH 8.2) containing 2% polyvinylpyrolidone (PVP MW 24,000) 0.02% NaN_3 and 0.05% Tween 20. Absorbance was determined at 405/450 nm on ELX800 Microplate Reader (Bio-Tek Instruments, Winooski, VT) and the sample was considered positive if its optical density was three times higher than the negative control.

Research goal was to develop potato elite seed production technology from *in*

vitro tube plants under special laboratory and open field conditions.

Results

Three types of potato cultivars: "Sante", "Amoroza" and "Nevsky" adapted for Georgian mountin region Akhaltsikhe and Tsalka were tested to develop elite seed production methods. Establishment of *in vitro* of potato varieties were performed using apical meristem methods on basal MS medium, potato cultivars were tested regularly 6 types of viruses (PVA, PVY, PVM, PVS, PLRV, PVX) [Fig-1].

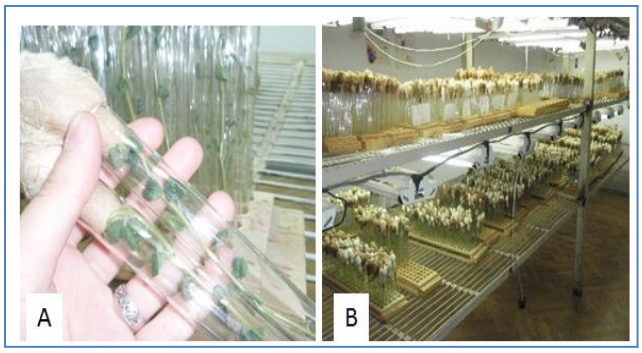

Fig-1 (A) *In vitro* Potato (B) Propagated *in vitro* Potato Varieties in Phytotron

STRENGHTEN OF PLANTS: *In vitro* potato tube plants were placed into plastic vessel contained soil that only top leaf stays above and put in Laboratory conditions during 5-6 days (Humidity-75%, day lighting, temperature 18-20ºC) and plants irrigated immediately with water [Fig-2].

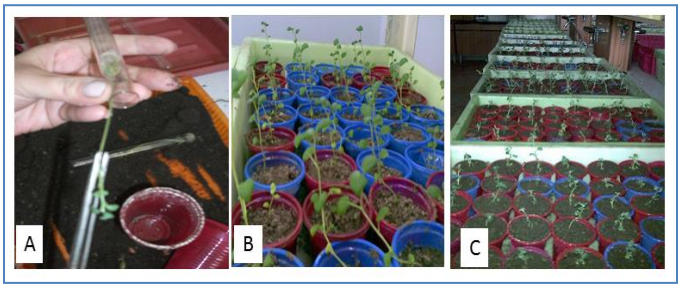

Fig-2 (A) Transmutation Process of *in vitro* Plants into Plastic Vessel, (B) Plants Transplanting Process in earthy Containers, (C) Strengthened Plants in Laboratory Conditions

These strengthen plants with strong root system, well formatted shoots and leaves were transferred to a semi-open-field as they were covered by a net during 8 days and then they continued growing in the open fielded conditions (Tsalka and Akhaltsikhe villages) [Fig-3].

Fig-3 (A)Potato with a Net in Open Filed, (B) Potato without a Net in Open Field

Number of potato microtubers received from tube plant accordingly to our developed method are 1.5-1 times more than stand art method [Table-1].

Table-1 *Number of Potato Micro Tubers from Each Plant*

Potato Cultivars	Number of Micro Tubers from Each Plant	
	From our Developed Method	From Standard Method
Amoroza	15-18	8-9
Nevsky	14-16	4-5
Sante	14-15	7-8

Yield of three types of potato cultivars (Sante, Amoroza, Nevsky) were studied in Gerogian Region Akhaltsikhe according to our developed method and only Two potato varieties were observed in Tsalka. It was releaved that Nevsky was characterized by high productivity (90.47%) with compare others, Sante and Amoroza showed the same results (70.67%/73.43%) in Akhaltsikhe, comparatively low yield was presented in Tsalka among two researched potato varieties: Sante (35%) and Amoroza (27.87%) [Table-2].

Table-2 *Number of Survival Plants according to Potato Varieties in Georgian Regions in 2010-2012 years*

Regions	Potato Varieties	Number of Plants	Survival Plants	Productivity (%)
Akhaltsikhe	Sante	3195	2258	70.67
	Amoroza	960	705	73.43
	Nevsky	420	380	90.47
Tsalka	Sante	1200	420	35
	Amoroza	4000	1115	27.87

[Table-3] and [Table-4] are presented harvest of potato cultivars from 100 strengthened plants in Georgian two Regions Akhaltsikhe and Tsalka during 3 years.

Table-3 *Harvest of Potato Varieties in Akhaltsikhe Region in 2010-2012 years*

Region	Potato Varieties	Number of Sample (piece)	Number of Micro tubers (piece) I year	Super-Super Elite seed(piece) II year	Super Elite Seed(Ton) III year
Akhaltsikhe	Sante	100	698	14897	4
	Amoroza	100	1290	27532	4.8
	Nevsky	100	1478	28680	5

Table-4 *Harvest of Potato Varieties in Tsalka Region in 2010-2012years*

Region	Potato Varieties	Number of Samples (piece)	Number of Micro tubers (piece) I year	Super-Super Elite seed(piece) II year	Super Elite Seed(Ton) III year
Tsalka	Sante	100	270	1 660	2
	Amoroza	100	831	18282	4.6

Results showed that potato cultivar Nevsky was characterized high Super elite seed Production ability (5t), Sante showed relatively low Harsvest in Tsalka, other results was the same amoung Georgian two region Akhaltsikhe and Tsalka [Fig-4].

Fig-4 Potato Elite Seed Yield in Open Filed from New Developed Method

"Nevsky" has been adapted from the 50s of the last century to the environment of Georgia, it is sustainable and easily adapts to different environmental conditions. An environmental condition of Akhaltsikhe was better for Sante reproduction than

Tsalka region. Therefore High Harvest of potato elite seeds were obtained from potato strengthened tube plants in Georgian two regions Akhaltsikhe and Tsalka, which is 3-4 times higher than the local production indicators. Our research is different from the apical method known through the world. The new method of plants translocation to semi-open field is presented in follows scheme

In vitro Tube plant -Laboratory
↓
Laboratory (semi green house) -Strengthen of plant
↓
Super-super elite seed -open field
↓
Super elite seed -open field

Super elite seed getting from the technology mentioned above is virus free, ecologically fresh product, (they do not require treatment by any chemical) than getting from the greenhouse.

Discussion

Among the agricultural crops, there were increase in the production of potato in Georgia between 2006 and 2016 [15]. Development of virus free potato elite seed production technology in field conditions is actual. [16, 17]. To improve the production system of seed potatoes in the world is necessary to establish more effective propagation system for the production and distribution of healthy and disease-free seed potatoes. The improvement potato seed production process including development both filed and laboratory skills [18]. Innovation technology of plants breeding resulted in numerous measurable prosperity for the economy, the environment and society in the EU in the last 15 years [19]. Acceptance of elite seed full cycle modification known all over the world was done in the conditions of Georgia. Particularly the full cycle: laboratory-greenhouse-open field was replaced by laboratory (phytotrone)-laboratory (plants strengthen in the semi greenhouse condition)-open field. Application of a method allows receiving from one virus-free plant without green house in field conditions free from pathogens of various diseases of potatoes, providing high productivity of seed potatoes. Georgian farmers received the local production elite seed by this technology. Developed method enables us to remove plants to open field without greenhouse. Potato elite seed getting from the technology mentioned above is environmentally friendly and at the same time it is economically profitable compared with imported seed. It was the first time in Georgia when super elite seed was produced from strengthen tube plants getting in laboratory It is important to continue further efforts to support agricultural development, the life of the people, and socioeconomic stability by managing seeds and seedlings, which are fundamental and significant components of agricultural production in Georgia.

Conclusion

Developments of full cycle of potato elite seed production was performed in the conditions of Georgia: laboratory replaced Laboratory-greenhouse-open field-semi greenhouse (plants strengthen in the laboratory condition)-open field. It is the first time that potato super elite seed was produced from strengthened *in vitro* plants in the laboratory condition –instead of greenhouse in Georgian regions: Akhaltsikhe and Tsalka. It was releaved that potato cultivar Nevsky characterized high elite seed Production ability (5ton), Sante showed relatively low Harvest (2ton) in Tsalka, other results were the same among Georgian two regions Akhaltsikhe and Tsalka.

Abbreviation:
IAA: Indole-3-acetic acid
NCSS: National Centre for Seeds and Seedlings

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Conflict of Interest: None declared

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