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TECHNOLOGY TO PRODUCE INITIAL MATERIAL OF POTATO SEEDS IN SOILLESS SETTINGS

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INTRODUCTION

It has become a vital issue to introduce advanced biotechnological scientific discovery and achievements and to use the results from research works in production based on the accumulated knowledge, experiences, technology, specialized professionals and laboratory production possibilities in this modern age of biotechnology which is developing as a lead scientific field and defining development and economic capacity of countries around the world.

In recent years, there has been numerous research works to produce potato minitubers using hydroponic and aeroponic methods in International Potato Center, Peru and they found that it possible to harvest 50-100 mini tubers from one plantlets. Moreover, in some African countries such as Kenya, such experiments have started.

In countries such as Democratic People's Republic of Korea, Vietnam, and China, the above mentioned technologies for applications in first stage test of potato seed breeding and in production have been very successful. For instance, in five states of Democtratic People's Republic of Korea, hydroponic potato minituber production technology was implemented and about 5 million minitubers are produced per year for domestic seed demand.

Recently, potato farming has been practice extensively in our country and total demand of the country is 185.000 tons out of which 140.000 tons are for food purpose and 45.000 tons for seed purpose. In 2012, potato production was 242.700 tons, potato import was 3.200 tons, and total potato production was 245.900 tons. In 2013, production was 190.170 tons, import 2.000 tons, export 1.500 tons, and total 190.670 tons. These are impressive facts demonstrating that the potato production of our country has exceeded the country demand.The virus-free seed production technology entered potato seed farming in Mongolia from 1996 and the advanced aeroponic technology was tested and introduced in 2007 and possibilities to cultivate 2 times per year and produce 180-200 thousand mini tubers became open.

ABSTRACT

Aeroponic comes from Latin words 'aero' meaning 'in the air' and 'ponic' meaning 'work, production' (Farran and Mingo-Castel, 2006). Aeroponic based minituber production methods is a process of strengthening plantlets grown in a laboratory and cutting their roots, transferring them into a greenhouse and producing root, stolon and tubers by spraying solutions containing macro and micro elements and growth substances in an ion form at specific frequency into the stems of the plants in the air in dark conditions.

Advantages of this method:

- Ecology-friendly technology
- More economically beneficial than other system
- The harvested seeds are healthy because of their growth in soilless settings
- Photosynthesis reaction is activated because the plants absorb nutrients 0.02% in a mist form and 99.8% in the air.
- Roots can develop conveniently in the air.
- The nutrient solution circle is 1.5ml/min in aeroponic while it is 1l/min in other similar methods such as NFT
- Increased chance of tubers getting bigger because tubers are picked selectively when they get to a standard size
- It requires a very little amount of water and nutrients and diseases do not spread from one plant to another.

Disadvantages:

- The whole aeroponic system can be infected when the hygienic, protection and quarantine requirements and rules are not met.
- Constant electricity is required due to automated equipment functions

Purpose of Research

To increase the number of minitubers from one plant by cultivating plantlets grown in soilless settings and to meet the domestic potato seed demand by introducing economically beneficial advanced technology and producing 180-200 thousand minitubers per year

Research field

The research of growing varieties of potatoes using cell culture method in in-vitro conditions was done in Plant biotechnology lab at the Institute of Plant and Agricultural Sciences (IPAS) and the research to produce minitubers in soilless settings was done in the aeroponic greenhouse at the laboratory.

Research methodology

The research was performed in Plant Biotechnology laboratory and the Aeroponic greenhouse according to the manual "Producing potato micro tubers in aeroponic and hydroponic systems" and "Fast growing potato seed materials" program confirmed by the Academic council of the IPAS.The virus-free potato plants from different varieties to transplant in aeroponic system was propagated in MS media and grown in the growth chamber with light frequency of 16 hour light and 8 hour darkness, air relative humidity 60-70%, and air temperature 23-25^{0}C. The plantlets for the aeroponic cultivation was acclimatized for aeroponic cultivation by getting transferred into artificial soil and strengthened for 7-14 days in the spring and fall. A 15-20cm long stem was cut from the strengthened plant and planted in a nutritious field of 20x20cm in an aeroponic equipment made from foam board with automatic control.The nutrient solution was operated with automatic control with timing mechanism that spray for 24 seconds at 5 minute interval until the tubers formed and 10 minute interval after the tubers started appearing. The tubers were harvested at 5g weight a 45 days after their cultivation and during their growth, we opened and closed a shade outside the greenhouse to prevent overheating and burning and to cool down the temperature for protection purposes.

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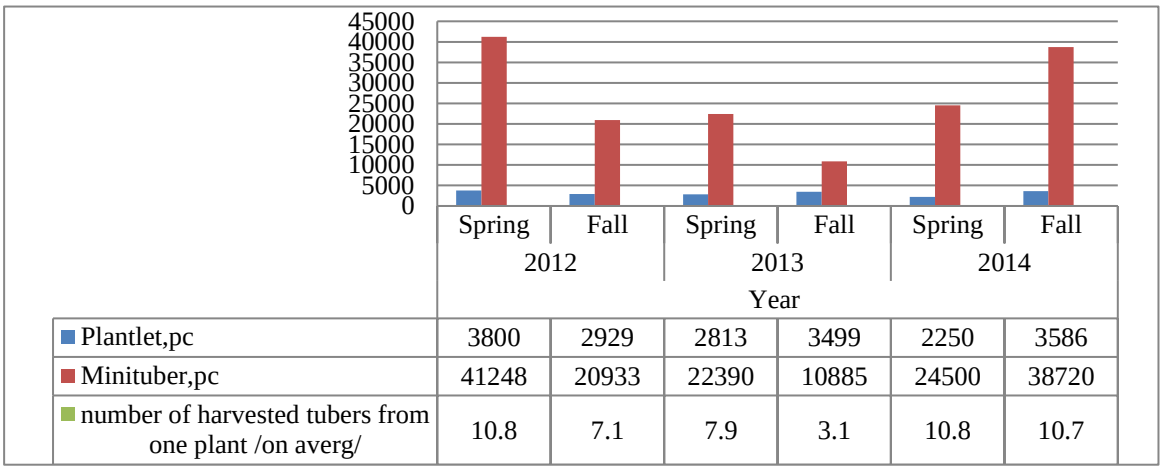
Research results

Comparatively, this advanced technology has higher multiplying coefficient, less human power, time and cost than the technology for seed tuber production that transfers plantlets into greenhouse soil and, as a result, the cost per tuber reduced 2.5 and one tuber costs 142.5 tugriks approximately.The micro plant is grown in a lab and the micro tuber is grown in a greenhouse with automatic settings, the latter is less dependent on the outer environment factors and it is possible to artificially configure the solution composition, temperature, and humidity conditions for the plant.

The special advantage of this technology was the fact that we could transfer virus-free micro plants into soilless environment and harvest sufficient amount of healthy, standard-sized micro tubers, spend water and nutrients at a minimal amount saving a huge amount and use ecology-friendly, modern and advanced technology. The produced mini tubers turned into initial material for elite seed farming and hence it became possible to compensate the cost from the production income and to conduct stable operation.We found out that we could plant already domesticated and could-be-domesticated varieties of potatoes in aeroponic and selectively harvest 20 mini tubers weighing 5-10g each on average from one plant. After transferring the harvested micro tubers into irrigated fields, we discovered that their livability was 90-95% and they are being multiplied as elite seed source material.

Picture 1. Technological process to produce potato minitubers in the aeroponic

Potato harvest from aeroponic in 2012-2014



	Spring 2012	Fall 2012	Spring 2013	Fall 2013	Spring 2014	Fall 2014
Plantlet,pc	3800	2929	2813	3499	2250	3586
Minituber,pc	41248	20933	22390	10885	24500	38720
number of harvested tubers from one plant /on averg/	10.8	7.1	7.9	3.1	10.8	10.7

During the research years, we transferred 18877 potato plantlets into aeroponic environment and harvested 15867 micro tubers.

Further results we aim to achieve

We aim to implement virus-free potato farming G-2 system that is used throughout the world in order to produce 450 tons of elite seeds, 180-200 thousand mini tubers per year aeroponically proceeding from the achievement of our current level of potato seed production techniques and technology, variety change, and seed renewal.

We will extend our laboratory, greenhouse, and aeroponic system and will cooperate with other research organizations, some licensed enterprise entities, and companies, which produce elite seeds, to achieve the level we aim for to produce 180-200 thousand minitubers every year using the new potato seed production G-2 system.

1. Domestic demand to produce elite seeds using the new seed production /G-2/ system

№	Seed propagatin year	Production amount /thousand/	Cultivation field /ha/	Yield per ha /ton/	Harvest / ton/
1	Mini tuber	180-200	-	-	-
2	Super-elite	-	3,5-4,0	20,0	75
3	Elite seed	-	20-24	20,0	450

We will produce 450 tons of elite seeds propagating in an open field for 2 years and will grow 180-200 thousand mini tubers per year with the two-year seed production scheme – G2./Table 1/

2. Calculation for domestic seed production with G-2 scheme /2014-2018/

	Year	2014	2015	2016	2017	2018
Elite seed production	Mini tuber /thousand/	180-200	180-200	180-200	180-200	180-200
	Super-elite /ton/	-	75	75	75	75
	Elite /ton/	-	-	450	450	450
Variety confirmed seed production	1st reproduction /ton/	-	-	-	1800-100	1800-2100
	2nd reproduction /ton/	-	-	-	-	8250-9000

We will begin producing 180-200 thousand mini tubers from 2014, 450 tons of elite seeds from 2016 domestically. This will give us a chance to produce 1,800-2,100 tons of 1st reproduction seeds from 2017 and 8,250-9,000 tons of 2nd reproduction seeds from 2018. /Table 2/

CONCLUSION

1.We planted potatoes that are already naturalized in Mongolia and also promising new varieties in aeroponic settings and deduced that it is possible to harvest about 20 minitubers, each weighing 5-10g, from each plant. The harvested micro tubers that are transferred into irrigated fields had survival rate of 90-95% and therefore they are successfully breeding becoming initial materials for elite seeds.

2. Furthermore, we aim to generate 180-200 thousand minitubers according to two-year seed culture scheme – G2, and to breed in an open field for 2 years to produce 450 tons of elite seeds with the purpose of having a possibility to produce 1800-2100 tons of seeds for 1st reproduction and 8250-9000 tons of seeds for 2nd reproduction by breeding further.

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