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Innovative research of ornamental plants in University of Debrecen (2001–2014)

Kaprinyák, T.

Department of Agricultural Botanical, Plantphisiology and Biotechnological, University of Debrecen
4032 Debrecen, Böszörményi u. 138.
Corresponding author: Tünde Kaprinyák (kaprinyak.tunde@agr.unideb.hu)

Summary: In the University of Debrecen started in 2001 related and biotechnology, genetic researches on climate-change-related. This work has already visible signs on the city's public spaces. The main goal of participants of the program is it that in Debrecen and in the surrounding communities more adaptable to the variable climate, ecologically and biologically more grounded urban ornamental planting are preferred in the next decade. The new results and ongoing researches of the decorative ornamental and biomass plants are an interdisciplinary breeding program.

Keywords: urban planning, propagation, breeding, biotechnology, ornamental plants

Introduction

In Debrecen Ferenc Pohl (***Figure 1***), the city's former chief gardener was who recognized a great aesthetic, ecological and economic significance of the ornamental plants in the modern approach of the city management and urban planning. Great support for deserving his work is still being felt. His biologically and ecologically grounded era-shaping approach is clearly visible in the public spaces, green-spaces of the city, especially in the line of trees.

In the University of Debrecen started in 2001 – with unified approach – the horticultural education on the ornamental plants-related and biotechnology, genetic researches on climate-change-related with Gábor Miklós Fári, leadership biotechnologist professor with professional help of one of his master, Dr. Zoltán Kováts (***Figure 2***) who was an ornamental plant breeder. This work has already visible signs on the city's public spaces. Primarily, the increased space and expertly prepared a summer planting ornamental plants deserve the acknowledgement of the city's residents. This among others due the competence of Mária Szabó, Zsiláné Anikó André and Judit Koroknai horticulturist researchers who Zoltán Kováts' teachings were able to succesfully put into practice. It is joyful thing, too that the once famous Pallag's Canna-research continues in Debrecen by Árpád Szíjjártó. In the following compilation we would like draw attention some new, innovative and transferable practice our ornamental researches for the professional public's interest. These beautiful results are connected with the city of Debrecen and with the University of Debrecen. The involved researchers and teachers of Debrecen ornamental innovation prepared themselves for wider introduction of the results of more than a decade work. The aim of participants of the program is it that in Debrecen and in the surrounding communities more adaptable to the variable climate, ecologically and biologically more grounded urban ornamental planting are preferred in the next decade.

Figure 1: Ferenc Pohl, former chief gardener of Debrecen

Figure 2: Zoltán Kováts, ornamental breeder of Budatétény

Researches in Uni Debrecen

Preservation of biodiversity and research of ornamental horticulture utilization opportunities of climate change-tolerant Salvia nemorosa L. natural populations *(research since 2009)*

Topic responsible:

Tünde Kaprinyák, agricultural engineer, horticulturist, PhD student

New results:

– series selection from high aesthetic value Salvia nemorosa shape- and colour versions (***Figure 3***) and fixing of genotypes with cloning;

Figure 3: Series selection from high aesthetic value *Salvia nemorosa* shape- and colour versions

Figure 4: New colour versions of the *Salvia nemorosa*

- selection of high aesthetic value *Salvia nemorosa* populations (***Figure 4***) and genetic fixing of populations with synthetic species production method;
- colour map of flower of the new variations;
- creation of *ex situ* genebank for preservation of the biodiversity of domestic natural *Salvia nemorosa* stock (***Figure 5***).

Figure 5: Creation of ex situ genebank for preservation of the biodiversity of domestic natural *Salvia nemorosa stock*

Ongoing researches:

- pathology characterization of *Salvia nemorosa* seed disease and molecular genetic identification of endogenous, exogenous fungi;
- induction of new *Salvia nemorosa* mutants with chemical and physical methods;
- creation of *in vitro* genebank from natural and induced *Salvia nemorosa* genetic stocks;
- bioactive materials of new *Salvia nemorosa* versions;
- colour – material biochemical map of flower of new *Salvia nemorosa* versions.

Genetics, morphology and biotechnology of perennial rhizome ornament grasses *(since 2011)*

Topic responsible:

Gabriella Antal, horticulturist, PhD student

New results:

- series induction from new shape- and leaf colour variants of high aesthetic value new Italian cane (*Arundo donax* L.) with biotechnology methods (***Figure 6***);
- selection of the new ornament Italian cane genotypes and fixing of the genotypes with cloning;
- external morphological description of the new ornament *macrophyla* and *longicaulis* Italian cane ecotypes and their separation (***Figure 7***);
- creation of *ex situ* genebank from the new and former Italian cane ecotypes for preservation of biodiversity of population (***Figure 8***).

Figure 6: Series induction from new shape- and leaf colour variants of high aesthetic value new Italian cane (*Arundo donax* L.) with biotechnology methods

Ongoing researches:

- tissue development of the ornament Italian cane and the Chinese ornament cane somatic embryos, three dimensional reconstruction of embryos and *time-laps imaging* examination of the increase;

- molecular marker of new ornament Italian cane ecotypes;
- induction of new ornament Italian cane mutants with chemical and physical methods;
- creation of *in vitro* genebank from natural and induced Italian cane genetic stocks;
- bioactive materials of Italian cane versions.

Figure 7: External morphological description of the new ornament *macrophyla* and *longicaulis* Italian cane ecotypes and their separation

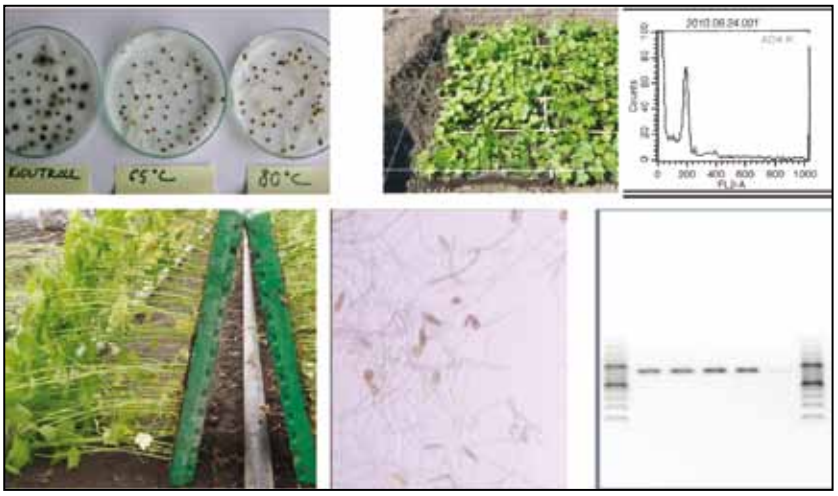

Figure 8: Creation of *ex situ* genebank from the new and former Italian cane ecotypes for preservation of biodiversity of population

Figure 9: New results of Pennsylvania ornament mallow *(Sida hermaphrodita)*

Morphology,genetics and biotechnology of Pennsylvania ornament mallow (Sida hermaphrodita) (research since 2009)

Topic responsible:

Erika Kurucz, agricultural engineer, PhD student

New results (***Figure 9***):

- selection of high aesthetic value Pennsylvania ornament mallow stem colour variations;
- fixing of new stem colour variations with cloning;
- morphological description of the new stem colour variations;
- pathology characterization of Pennsylvania ornament mallow seed disease, molecular genetic identification of endogenous and exogenous fungi;
- development of new nanny nurse tray method (nurse-in-tray);
- creation *ex situ* genebank from the new and former Pennsylvania mallow ecotypes for preservation of biodiversity of the population.

Ongoing researches

- the pennsylvania mallow organogenesis and research of *in vitro* regeneration on the genetic transformation scientific foundation;
- molecular genetic identification of the Pennsylvania mallow;
- induction of the Pennsylvania mallow mutants with chemical and physical methods;
- creation of *in vitro* gene bank from natural and induced Pennsylvania mallow genetic stocks;
- bioactive materials of Pennsylvania mallow seed.

Horticultural and biotechnical research of the plant live-picture system (PLANT LIVING PICTURE, HORT-IN-BOX, HIB) (research since 2012)

Topic responsible:

Judit Koroknai, horticulturist, PhD student

New results:

- design and construction of high aesthetic appearance plant live-picture modules (***Figure 10; 11***);
- selection of media and suitable plants for plant live-picture modules;
- water balance of the plant live-picture modules in different species associations.

Figure 10; 11: Design and construction of high aesthetic appearance plant live-picture modules

Ongoing researches:

- stress physiology and photosynthesis of the plant live-picture modules in different species associations;
- biological lifecycle of the plant live-picture modules in different species associations;
- plant protection of the plant live-picture modules in different species associations;
- new plant species of the plant live-picture modules;
- possibilities and limitations of automated maintenance of plant live-picture modules;
- economics of the plant live-picture modules.

New ornamental plants in Hungary. Naturalization of the Brazilian ginseng (Pfaffia glomerata* L.*) and Huegel mallow (Aliogyne huegelli)

Topic responsible:

Pál Szarvas, biologist, PhD student (2006-2013) and Tünde Kaprinyák, agricultural engineer, horticulturist, PhD student (2013-)

New results:

- *in vitro* propagation of the without seed Brazilian ginseng in the bioreactor (***Figure 12***);
- definition of ornamental horticulture value of Brazilian ginseng (***Figure 13***);
- plant protection of Brazilian ginseng *in vitro* propagation of Huegel mallow;
- definition of ornamental horticulture value of Huegel mallow (***Figure 14***);
- polyploidization of Huegel mallow;
- plant protection of Huegel mallow.

Figure 12: In vitro propagation of the without seed Brazilian ginseng *(Pfaffia glomerata* L.) in the bioreactor

Figure 13: Definition of ornamental horticulture value of Brazilian ginseng

Figure 14: Definition of ornamental horticulture value of Huegel mallow *(Aliogyne huegelli)*

Production of yellow crop-cover ornament oil tree (Ricinus communis) and crop removal pruning of ornament oil-tree

Topic responsible:

Zsiláné Anikó André, horticulturist (2004-2010) and Judit Koroknai, horticulturist, PhD student (2010-2012)

New results:

- comparative examination of selected in Budatétény and the abroad ornament oil tree populations in the northern - plan region;
- searching of new ornament oil tree mutants on the basis of crop-cover colour;
- selection and appearance of yellow crop-cover ornament oil tree mutants (***Figure 15***) and the generative propagation of the progeny generation;
- fixing of low and medium-high yellow crop-cover ornament oil tree;
- development of pruning method of ornamental oil tree;
- ornamental value description of without crop branches oil tree species.

Figure 15: Selection and appearance of yellow crop-cover ornament oil tree (Ricinus communis) mutants

Technical innovation – seedling with growth reducing machine

New results:

- Judit Koroknai leadership – Krisztina Lénárt horticulturist, BSc student – prototyp develop and test for Zoltán Kováts' ornamental annuals and other plants (*Celosia, Tagetes*, etc) (***Figure 16***).

Figure 16: Technical innovation – seedling with growth reducing machine

Micropropagation of ornamental plants in phyto-bioreactors

Topic responsible:

Gabriella Antal, horticulturist, PhD student (2006-2010)

New results:

- testing of the world's first multi-function phyto-bioreactor (***Figure 17***);
- micropropagation protocol development of multi-functional phyto-bioreactor on *Hosta sp*. model plant (***Figure 18***;
- micropropagation protocol development of multi-functional phyto-bioreactor on *Iresine sp*. model plant (***Figure 19***).

Figure 17: Testing of the world's first multi-function phyto-bioreactor

Figure 18: Micropropagation protocol development of multi-functional phyto-bioreactor on *Hosta* sp. model plant

Figure 19: Micropropagation protocol development of multi-functional phyto-bioreactor on *Iresine* sp. model plant

Biotechnology of rare european orchid species

Topic responsible:

– Tünde Kaprinyák, agricultural engineer, horticulturist, PhD student (2013-); Edit Szarvas, horticulturist, BSc student, Dr. Attila V. Molnár; Dr. Eszter Eszéki R. and Tillyné Dr. Andrea Mándy

New results:

– asymbiotic seed sowing and *in vitro* planting of rare european orchid species (*Orchis iberica, Ophrys fusca)* (***Figure 20***);
– use of 'Double-layer' method for promotion homogeneous intensive sprouting of orchids.

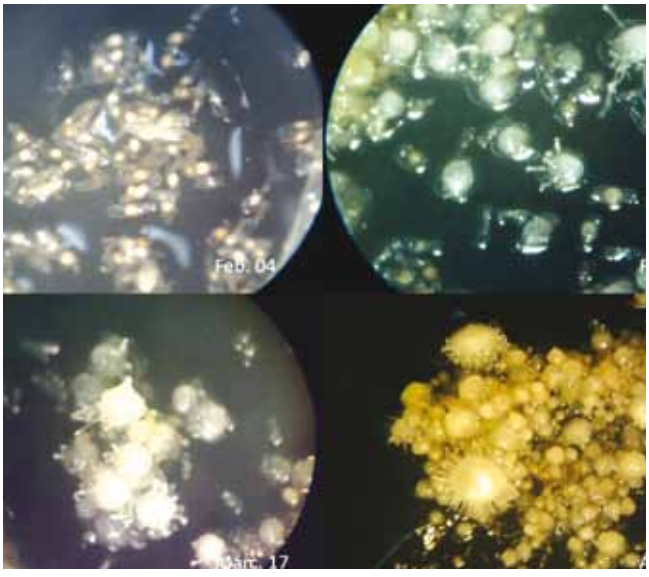

Figure 20: Asymbiotic seed sowing and in vitro planting of rare european orchid species

Ongoing researches:

– bioreactor technology adaptation for sterile propagation of rare european orchid species.

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