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The First Clustering Centre on Plant Biotechnology in Romania

Camelia Sand Sava[1,✉] and Maria-Mihaela Antofie[1]

SUMMARY. Plant biotechnology starts to develop worldwide in the beginning of the XXth century and it took more than 60 years to become recognized as an important pillar for supporting food security at the global level. Later on, after 1990 plant biotechnology become part of the bio-economy. Researchers from Romania recovered a lot in developing plant biotechnology as a science between 1970 and 1990. Still technology transfer from research to industry was pioneered with the support of researchers from the Biological Research Center Cluj-Napoca, Romania and implemented in Brașov County in 1988 when started the construction of the Plant Biotechnology Laboratory of Sere Codlea. In the next two years other three institutions have been developed clustering for the first time higher education, research and industry in 1990. The scope of this article is to emphasize relevant moments for the development of the cluster centre for plant biotechnology in Brașov County. Thus, the Biological Research Center Cluj-Napoca, three research institutions and one industry partner dedicated for plants biotechnology (e.g. ornamental plants, potato, sugar beet and grasses) implemented relevant mechanisms for technology transfer from research to industry. The Plant Biotechnology Laboratory of Sere Codlea, dedicated for ornamental and potato biotechnologies, collapsed due to the inconsistency of development policies before 2000. The other three research institutions joined together in a single one institute due to research policies of the time. That was one of the greatest losses of the country in terms of human and financial resources in supporting food security of the country and therefore Romania needs to recover these values for the future generations.

Keywords: clustering, crops technology, plant biotechnology policy, technology transfer, Romania.

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[1] *University "Lucian Blaga" from Sibiu, Faculty for Agricultural Sciences, Food Industry and Environmental Protection, 7-9 Dr. Ioan Ratiu Str, Sibiu, Romania, 550012.*

✉ ***Corresponding author: Camelia Sand Sava****, University "Lucian Blaga" from Sibiu, Faculty for Agricultural Sciences, Food Industry and Environmental Protection, Sibiu, Romania,*
E-mail: camelia.sand@yahoo.com

Introduction

The development of plant biotechnology became more than a necessity for the future of our country early in the ’80, due to the enormous economic gains promoted all over the world: quick development of new cultivars, access to a new generation of techniques and improve quality of life (Nisbet and Lewenstein, 2002). Thus, starting with that period Romania promoted the patenting in this domain and later in 1996, accessed the TRIPS (Trade-Related Aspects of Intellectual Property) (Boettiger *et al*., 2004), for supporting plant biotechnology for agriculture. Before 1980, the transfer of technology between research and industry with excellent results for the economy of the country was established (Lenaerts and Merlevede, 2015). After the communism fall, due to the rapid and dramatic political changes, Romania encountered a series of issues in continuing connecting research and industry with negative impact on biotechnology development (Borşa *et al*., 2011). After the national initiation of plant biotechnology at the industrial level that started in 1988 with the opening of the Plant Biotechnology Laboratory of Sere Codlea, we assisted 15 years later to a dramatic fall of many industrial platforms due to political incoherence in this domain (Sima *et al*., 2015). The Biological Research Center Cluj-Napoca through Professor Dorina Cachiță-Cosma played a central role in plant biotechnology development in our country and namely in clustering for the first time a series of five institutions belonging to higher education, research and industry (Cachiţă-Cosma and Vicol, 1990). The aim of this article is to present the major achievements of plant biotechnology clustering in Brașov County, Romania.

Materials and methods

This article is based on the historical analysis of the evolution of plant biotechnology in Romania, when the first clustering process in plant biotechnology became reality in Brașov County. Capacity building opportunities will be discussed based on a SWOT analysis.

Results and discussion

Plant biotechnology developed first based on recognizing defined principles of the Cell Theory published in 1838 by Schleiden and Schwann (Vasil, 2008). First experiments in plant biotechnology for cultivating plants in sterile conditions and accepted by the scientific community have been published in 1920 by Wilson. Step by steps these techniques become more and more accurate. Moreover they proved to become reliable parts of a new promising technology (White, 1934) if accessing theoretical background of plant development according to theory on totipotency (Haberlandt, 1902). Between 1902 and 1934, the scientific community contributed to the generation of a new technology at the laboratory level and attempts for piloting their results have been published. After the Second World War the research is more and more oriented for proving the economic efficiency which finally acted in 1968 with the Green Revolution in Pakistan for fighting in ensuring food security for the poor (Nulty, 1972). After 1994, we assisted to a new era of plant biotechnology due to the production of first genetically modified crops species (Vasil, 2008) and today new techniques may further contribute to plants breeding (Lusser *et al*., 2012). Thus, between 1970 and 1990 at the global level it is a fertile period for the development of plant biotechnology solved with the successful transfer from the laboratory to industry level with strong economic rates. Unfortunately, Romania was not participating in the same period of time to the historical achievements of plant biotechnology as a new scientific emerging field. After 1970 the scientific community become aware about the benefits of these technologies that in the end of the ‘80 it is finalized with the development of a cluster centre on plant biotechnology. Brașov County is recognized for its huge traditional potential for potato and sugar beet production, for more than 100 years (Chiru *et al*., 2008a). Clean air, fertile soil, free viruses areas over 1000 m altitude and excellent communication are among the major features taken into account for setting this cluster for plant biotechnology development in close connection to the crops species, very popular in the region. The entire philosophy in behind this strategy was to connect higher education, research and industry for technology transfer, as a first step in the sustainable development of the country. Six focused PhD thesis, treating specific technology transfer, have been published in these cluster institutions in only 7 years (Sand, 1995; Sandu, 1998; Bălan, 1999; Constantinescu, 1999; Chiru, 1999 and Antofie, 2002).

The first industrial laboratory for obtaining free viruses plants. To be successful in coupling research and industry it is a great need of committed partners. Thus, the first largest laboratory for *in vitro* plants cultivation at industrial level was constructed in Romania between 1983 and 1987 with the commitment of the greenhouse state company Sere Codlea from Brașov County positioned at the foot of the mountain Măgura Codlei. The construction was supported by Eng. Ioan Băloiu the Director of this institution following the planning proposed by Professor Dorina Cachiță Cosma. This laboratory was placed in the neighbourhood of the decidual forests with strong descendent air currents all over the year. Such a place is important to keep away insects that may be virus vectors (Pop *et al*., 1992). The laboratory was projected to support a full activity of the green house (i.e. 200 ha of greenhouses) as well as other at least 3000 small producers distributed all over the country. The objectives of research conducted in Sere Codlea were to develop *in vitro* micropropagation technologies for free viruses plants (i.e. potato and ornamentals species), to find the best technological solutions for *in vitro* inoculation, micro-propagation, pre-acclimation, acclimation and further for obtaining best results in super-elite plants. More than 40,000 carnation plantlets for more than 130 cultivars were transferred twice per year from the laboratory to the green house but in forced conditions it was possible to obtain up to 150,000 plantlets in 6 months. The technological flow was designed to include steps such as super elite and three levels of elite plants (i.e. elite I, II and III) for the commercial use (Petricele *et al*., 2009). A laboratory of over 800 m^2, respecting all international recommendations for biotechnology flow systems and equipped with the most modern infrastructure gave a constant financial gain of over 30% to the company. The lab complex comprises: i) a sterile part (i.e. an inoculation room equipped with 10 laminar flow hoods (each for two persons), 21 microscopes, a sterile lobby for sterile equipment, a deposit room, a room for culture media preparing and a sterilizing room), and ii) a non-sterile part (i.e. 6 growth chamber rooms for over 60,000 inoculate, a room for thermotherapy for up to 160 plants, a room for washing jars).

The personal was highly trained: 180 meristems/person/ 8h and 450 tubes of microporpagated plant material/8 h. Next to laboratory was constructed a 5,000 m^2 of greenhouse with couples of sections: acclimation (i.e. 6 greenhouses for 10,000 plantlets/each) pottery (i.e. 8 greenhouses for 600 each) and a sector for elite classes dedicated for commercial purpose. Highly instructed persons (1 per module) and a good management proved that such infrastructure may function properly. For almost 15 years this laboratory became the major supplier for ornamental species and potato plants free of viruses. Later, between 1996 and 1998, over 100,000 potato minitubers, viruses free, have been trade with a price 100 times lower compared to the market place (i.e. 100 minitubers/0.15 US dollars). The research was extended to gerbera free of pathogens with almost 10 meristems per plant (i.e. helical disposition into the apical meristem) and a rate of 30 meristems/person/8 h. At least 20 cultivars of gerbera were micropropagated in this lab for industrial purpose (Antofie *et al*., 1998). Over 30 cultivars of *Chrysanthemum sp. Saintpaulia* and tropical ornamental plants species were the subject of research for increasing the germplasm collection for indoor plants and for technology transfer as well.

Clustering plant breeding in Brașov. In 1990 also with the contribution of the Biological Research Center Cluj-Napoca, namely of professor Dorina Cachiță-Cosma it was set up the Institute for Research and Development for Potato (IRDP), the Research Institute for Pastures (RIP) and the Research Institute for Sugar Beet (RISB) all three located in Brașov area. Thus, Sere Codlea contributed in personnel training and transfer in a highly organized research structure of IRDP closely working with research stations in the country for supporting the trade of the best potato cultivars in the country. This institute named today as the National Institute of Research and Development for Potato and Sugar Beet Brasov (NIRDPSBB) registered in 25 years of existence 22 patents for 22 potato cultivars cultivated all over the country (Chiru *et al*., 2008b). Today the institute includes also the former RIP and RISB. Moreover 9 patents for sugar beet have been published by this institute supporting further their mission to connect research with industry according to the pioneer of the process (Mansfield, 1975). It is a fact that the Romanian policy was supporting the clustering of research institutions as a new mechanism for making more cost-efficient the process of technology transfer that is now, after 25 years, a new challenge at the global level (Palcic and Pandza, 2015). The current policy in research and development need further to support for the re-organization and development of these clusters on plant biotechnology as they will become more important in the future for supporting food security (Anderson *et al*. 2016) in a changing climate (Marcucci and Turton, 2015).

Conclusions

Four institutions, placed in Brașov County, have been created as a first cluster of plant biotechnology for supporting the Romanian bio-economy and for ensuring food security on long term.

A huge human resource has been trained and large financial resources have been invested into these institutions with constant revenue for industry of over 30%.

Despite of the positive results for technology transferring from research to industry, due to the political inconsistency in continuing the coupling between industry and research, this investment collapsed after 2004.

Important human resources remained in the NIRDPSBB with large implications from intellectual property rights due to 37 published patents on crops varieties.

Romania has a huge potential for developing clustering mechanisms in the transfer of technology and acting between research and industry that may be accessed for the support of food security policy in the context of the European Union.

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