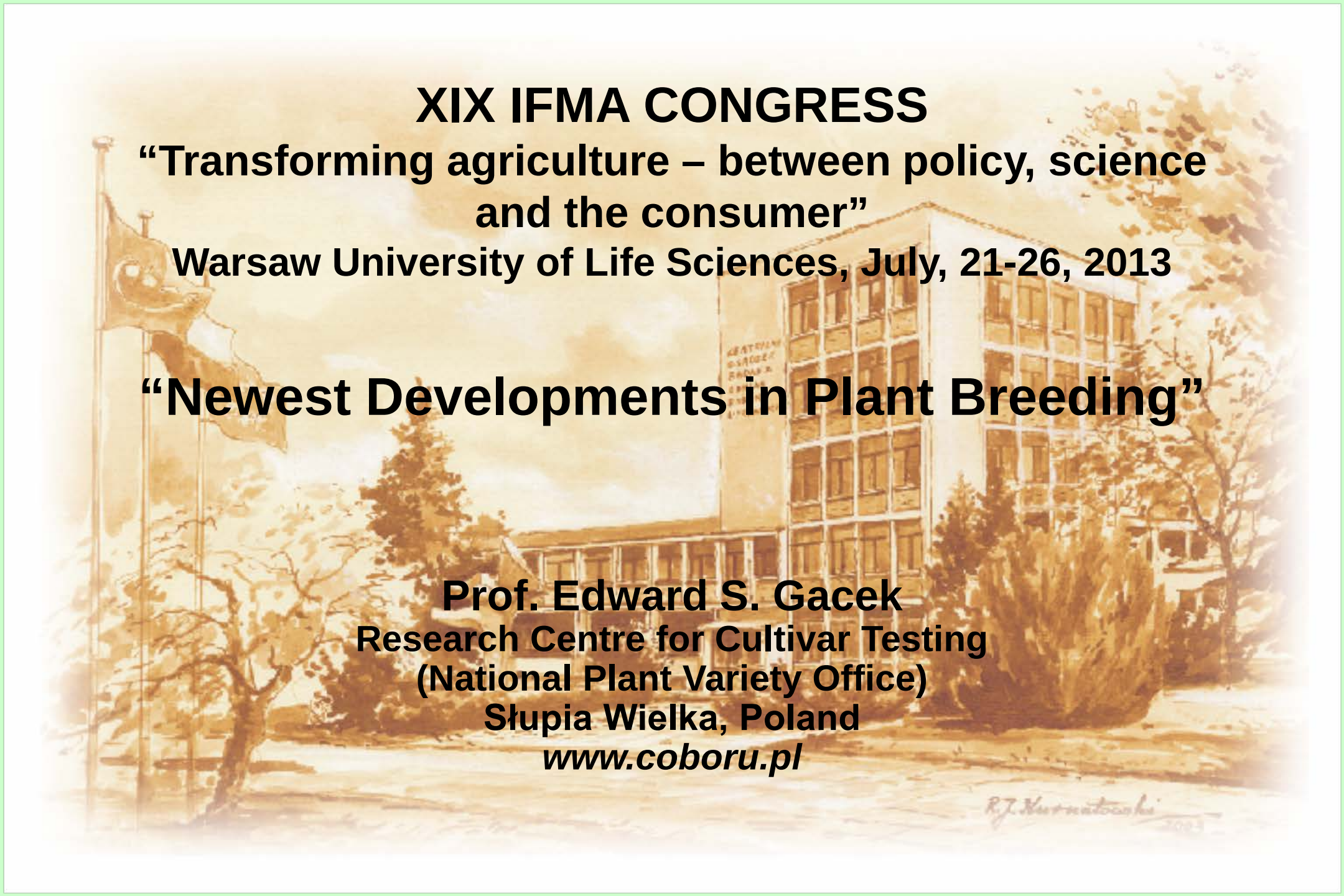

XIX IFMA CONGRESS

"Transforming agriculture – between policy, science and the consumer"

Warsaw University of Life Sciences, July, 21-26, 2013

"Newest Developments in Plant Breeding"

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Introduction

- **over the last decades agricultural production have increased significantly, thanks to:**
  - **specialization of farming systems, and**
  - **breeding of high yielding and adapted cultivars**
- **however, major questions have arisen concerning the economic, social and environmental costs, associated with high input production**
- **farmers are faced with many limiting factors and seek varieties that are both adapted to their different production systems and environments**
- **the need for innovation, mainly through different new varieties is more relevant, than ever**

Characteristics of modern plant breeding (1)

- **half of the increases made with regard to agricultural productivity, are the result of progress in genetics and plant breeding**
- **it is of vital importance to promote the development varieties:**
  - **helping us, to achieve stable and high productivity**
  - **at the same time needing less inputs, and**
  - **being more resilient and better adapted to the effects of climate change**
  - **conservation varieties, populations (CCPs) and farmers' varieties**
- **the dominating pedigree line breeding approach, has narrowed the genetic base of many of our crops**

Characteristics of modern plant breeding (2)

- **over the last decades, plant breeding has greatly benefited from:**
  - **precision phenotyping**
  - **genomics**
  - **bio-informatics**
  - **and other molecular tools, to monitor heritable variation during selection**
  - **development of relevant intellectual property protection systems for the plant breeding and seed industry**
- **seed and plant variety legislation, including an effective legal protection mechanisms of varieties and plant-related innovations, are at the core of bringing modern varieties to farmers fields**

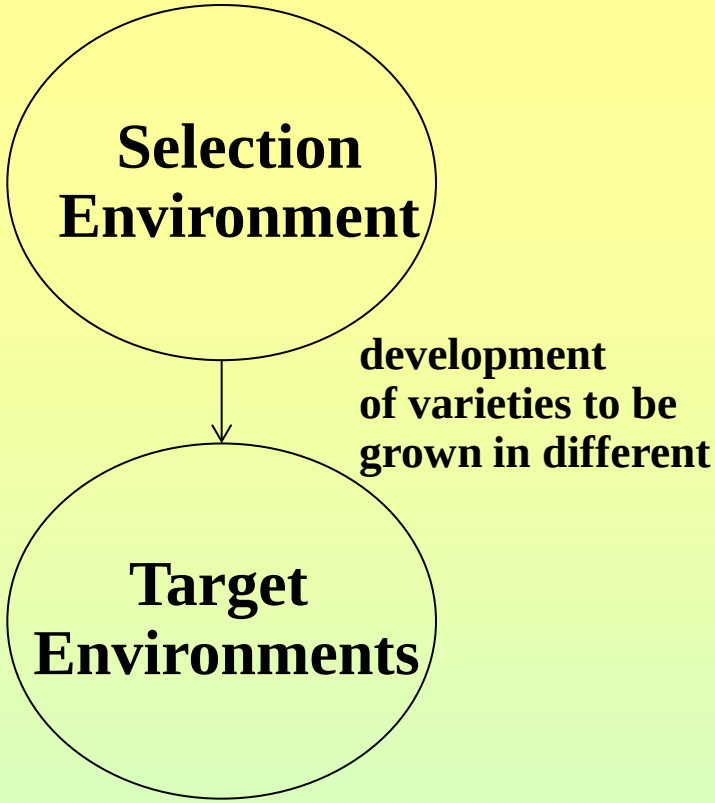
Characteristics of modern plant breeding (3)

- **Many countries are struggling to facilitate ready access by farmers to recent breeding gains**
  - **millions of farmers in Africa, Asia and Latina America grow outdated, local varieties, and**
  - **they suffer from the lack of information about newest ones**
- **different markets in these areas, combined with different innovation systems, require different breeding approaches**
- **problems with dissemination of knowledge to key stakeholders (farmers', extention services, seed companies, policy-makers, national offices for registration and seed control, food industry and consumers)**

Characteristics of modern plant breeding (4)

- **Current plant breeding activities concentrate on three main directions, namely:**
  - **conventional pure line breeding programs, mostly in the large commercial breeding companies, aimed at development pure line varieties for conventional, high-input agriculture**
  - **evolutionary plant breeding programs, aimed at development of heterogeneous material, in the form of composite – cross populations (CCPs), to be used mostly in low input and ecological agriculture**
  - **participatory plant breeding (PPB) for sustainable crop improvement, aimed at breeding varieties adapted to local agro-climatic and agro-economic conditions**

Conventional plant breeding



- all decisions are taken by the breeders teams, and selection work done at breeders environments
- final products – conventional varieties, (with DUS/VCU criteria)

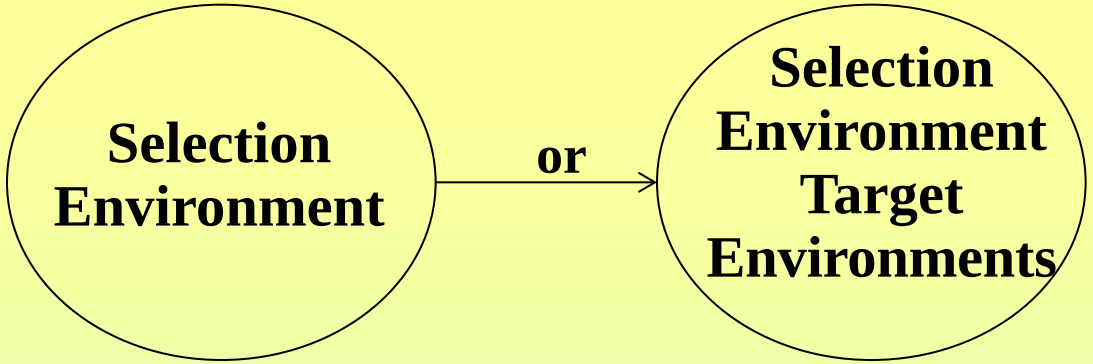
Line breeding approach (1)

- **the type of breeding work, aimed at uniformity:**
  - **pure line varieties**
  - **open pollinated varieties**
  - **F_1 – hybrids**
- **the pedigree line breeding approach, has narrowed the genetic base of many of our crops**
- **as a result, monocultural plant communities dominate modern agriculture**

Line breeding approach (2)

- monocultures are crops of a single species and a single variety
- monocultures, very popular in world food production have today many failures, due to the loss of genetic diversity and the low resilience in many agro-ecosystems
- more recently, major questions have arisen concerning the economic, social and environmental costs associated with line breeding approach, and high input production, in monocultures

Evolutionary plant breeding



- **final products: mostly populations (CCPs), without DUS,**
- **developed during formal / informal research**

Evolutionary plant breeding approach (1)

- this approach, despite of long history has so far not become part of mainstream breeding research, nor has it been implemented in practice
- composite – cross populations (CCPs) developed during evolutionary plant breeding process, cope better with stresses:
  - good resistance against pests and diseases
  - ability to react to environmental and climatic variability
  - evolutionary adaptation to local conditions
- benefits of CCPs are not yet exploited in practice to higher degree

Evolutionary plant breeding approach (2)

- **over the last decade, research in evolutionary plant breeding has markedly intensified**
- **in addition, interest in evolutionary plant breeding is growing among farmers, breeders and policy makers**
- **there are currently encouraging developments in the revision of seed legislation in the EU, that could lead to more room for evolutionary plant breeding approaches, in the future**

Evolutionary plant breeding approach (3)

- **Advantages of growing CCPs, and other heterogeneous material:**
  - **higher level of genetical diversity**
  - **lower disease and pests pressure, within the fields**
  - **better buffering: more stable yields**
  - **opportunity for adaptation to local / regional conditions**
  - **beneficial on the long – term, for protecting agro-biodiversity**

Participatory plant breeding

- possibility to conduct direct selection in the target environments
- benefit from farmers experience and expertise in varietal evaluation in their particular environments
- final products: farmers' varieties (diverse situation of their homogeneity)

Participatory plant breeding approach (1)

- participatory plant breeding (PPB) is an effective pathway to develop strains of crop varieties, adapted to local conditions, and to maintain genetic diversity among the varieties cultivated
- the term of PPB refers to a set of breeding methods, characterised by many different potential forms of interaction between farmers and breeders
- PPB is characterised by varying degrees of interaction between farmers and breeders, at different stages of breeding process

Participatory plant breeding approach (2)

- **„complete participation breeding” (CPB),in which farmers and breeders collaborate continuously, throughout the breeding process**
- **„participatory varietal selection” (PVS) in which the initial stages of the breeding process are performed exclusively by breeders, and farmers participation is restricted to evaluating finished material**
- **participatory crop research is often built on the same model as conventional research, only with the added element of participation from farmers**

Participatory plant breeding approach (3)

- **PPB enables crop to evolve under the combined effects of natural and artificial selection, and**
- **takes into account the diversified management practices, needs, expectations and traditions of farmers and consumers preferences**
- **in this approach breeders produce of improved germplasm (populations and/or varieties) specifically adapted to the above mentioned conditions**
- **47 countries, have or have had PPB programs on 26 crops, mostly in Africa, Asia, Latin America, to some extent in USA, Canada, and to very small extent in southern EU countries**

Some aspects of intellectual property protection in plant breeding (1)

- **in order to stimulate innovation in conventional plant breeding, legal protection mechanisms, are needed:**
  - **for new plant varieties (fulfilling DUS requirements)**
  - **for plant- related innovations, being products of modern biotechnology**
  - **for enabling technologies**

Some aspects of intellectual property protection in plant breeding (2)

- **types of plant innovations in plant breeding:**
  - **new plant varieties**
  - **phenotypic traits (genes, genetic sequences, lab. tools, software etc.)**
  - **some genetic resources**
  - **enabling technologies**

Some aspects of intellectual property protection in plant breeding (3)

- **Enabling technologies:**
  - **gene silencing technology**
  - **promoters**
  - **transformation technologies**
  - **vector systems**
  - **selection markers**
  - **hybrid systems**
  - **other**

Some aspects of intellectual property protection in plant breeding (4)

- **Plant variety protection (PVP), and UPOV:**
  - **the International Union for the Protection of New Varieties of Plants, known as UPOV, is an intergovernmental organization, with headquarters in Geneva (CH)**
  - **the UPOV system of plant variety protection (PVP) is designed to encourage innovation, in the field of plant breeding and seed production**

Some aspects of intellectual property protection in plant breeding (5)

- **the UPOV Convention provides a *sui generis* form of IP protection, for the plant breeding community**
- **innovations in other areas of technology concerning plants, are covered by other forms of IP right, including in particular patents**

Some aspects of intellectual property protection in plant breeding (6)

- **To be eligible for protection, a plant variety have to be:**
  - **distinct from existing, commonly known varieties (criterion – D)**
  - **sufficiently uniform (criterion – U)**
  - **stable (criterion – S), and**
  - **commercially new (in the sense of its presence on the seed market**

THANK YOU FOR YOUR ATTENTION