

NATIONAL AGRICULTURAL RESEARCH & DEVELOPMENT INSTITUTE – FUNDULEA
(NARDI)

NARDI is the largest agricultural research institute of Romania. Founded in 1957, it is the main successor and continues the research activity on field crops, developed at the former Agricultural Research Institute of Romania (ICAR), founded in 1927. NARDI focuses on some of the most important crops of Romanian agriculture, namely small grains cereals, maize, sunflower and forage crops, which together account for around 90% of total arable land of the country.

The mission assumed by NARDI has been **to improve the living standards of Romanian farmers, by increasing their contribution to European field crop production.**

The main directions of NARDI research are:

1. to improve farm economic results, by increasing the efficiency of **using natural resources and technological inputs, for a sustainable agriculture, in the context of climate changes;**
2. to improve **quality** of field crops production, according to market and consumers' requirements, for better competitiveness on internal and international markets;
3. to develop fundamental research, meant to open **new ways of progress in applied research.**

1. In order to improve farm economic results, by increasing the efficiency of using natural resources and technological inputs, for a sustainable agriculture, in the context of climate changes, the main **objectives** are:

- Improving the germplasm of main crops for drought and extreme temperatures resistance;
- Adapting crop management practices to predicted climate changes for more efficient use of water from both rainfall and irrigation;
- Improving the germplasm of main crops for increased nutrient use efficiency and tolerance to unfavorable soil conditions;
- New low cost crop management systems with higher input use efficiency. A special attention is given to conservative agriculture;
- Improved integrated, environmental friendly crop management practices to prevent and control weed, disease and pest infestations;
- Increasing the bio-diversity of field crops.

2. In order to improve the quality of field crops production, according to market and consumers' requirements, for better competitiveness on internal and international markets, the main objectives are:

- Improving the germplasm of main crops regarding the genetic potential to accumulate essential quality components;
- Crop management and plant protection systems to minimize accumulation of toxic or potentially damaging compounds and to favor accumulation of components with favorable effect on human health;
- Improving crop management practices and cultivars for organic agriculture, to allow economic results competitive with traditional agriculture.

3. In order to develop fundamental research, aiming to opening new ways of progress in applied research the main objectives are:

- Developing research in genetics, molecular genetics, genomics and proteomics, to open new prospects in breeding future cultivars;
- Exploring new breeding approaches to shorten the duration of cultivar creation and to accelerate genetic progress;
- Developing research on physiology of yield and quality formation, to identify new ways of improvement. Development and adaptation of mathematic models for crop grows, yield and quality simulation, and their coupling with teledetection will be approached.

The results of more than 50 years of activity could be summarized as follows:

- breeding and releasing more than 340 cultivars and hybrids, adapted to the difficult environment of Romania. These have been widely adopted by Romanian farmers, being presently grown on more than 1.7 million hectares. Some of the NARDI creations have been registered and grown in other countries, such as Hungary, Turkey, Argentina, Spain, etc.
- producing breeder's seed and first multiplications of own cultivars and hybrids, in quantities corresponding to farmers requests. An average of 4,000 tons of seed of superior categories are produced every year;
- Recommending continuously improved and up-dated crop management practices, corresponding to the specific requirements of new cultivars, to contribute towards sustainable, environmentally friendly farming.

NARDI is organized in two Sections: Research and Development.

Research is organized in two Departments:

- Germplasm improvement (including teams working on Genetics and genomics, Biotechnology, and Breeding wheat and triticale, barley, maize, sunflower, grain legumes, forage crops, linseed and medicinal plants, Seed production)
- Systems of sustainable agriculture (including teams working on Water and nutrients management, Crop and environment protection, Quality and security of agricultural production, Physiology of yield formation and stress response)

An Agro-ecological Center for research, innovation and technological transfer functions as a distinct unity directly subordinated to the Director and cooperating with all research departments.

The research activity is supported by several teams included in the compartment Services to research.

The development activities are organized in three farms for seed multiplication, a seed processing unit, a mechanical sector, and several supporting teams.

NARDI has a total of 330 employees (174 in the research section and 156 in the development section), out of which 54 are researchers.

NARDI administrates 1911.94 hectares, out of which 1689.18 arable. Facilities are available both for research (automated greenhouse, laboratory equipments, equipments for mechanization of experimental fields operations, etc.) and for seed multiplication (seed processing units, storage facilities, field equipments etc.). INTERNET connections are available for all existent PC's.

NARDI is involved in many bilateral international cooperation projects, with international research centers, institutes, universities and private companies. Many activities are directed towards dissemination of research results, both nationally and internationally. NARDI publishes a scientific journal in English (Romanian Agricultural Research), ISI indexed since 2007, and abstracted in ISI web of Science, Science Citation Index Expanded and CAB abstracts

Among the main NARDI research projects, the following can be given as examples:

a) IMPROVING THE GENETIC BASIS OF WHEAT CROP, THROUGH BREEDING NEW, SUPERIOR CULTIVARS.

Wheat is the second crop and first in human consumption in Romania, but yields are very variable, reflecting mainly limiting climatic factors. An adapted cultivar can help increase yields and reduce yield fluctuations. Wheat cultivars introduced in Romania from countries with different weather conditions lack traits that are essential for adaptation (mainly drought resistance or winterhardiness). The private sector has invested much less in wheat breeding worldwide, and there is no private wheat breeding program in Romania yet, therefore there is a need for public involvement.

Research and breeding efforts have been directed towards reducing the effect of main limiting factors (both abiotic and biotic), including those which are expected to have higher impact as the result of predicted climate changes.

Modern methods have been used to reach these goals, such as

- speeding up creation of new wheat cultivars, using the *Zea* system biotechnology, for rapidly obtaining homozygous plants;
- using molecular markers (both newly identified – e.g. for osmotic adjustment, and identified by other research teams) for marker assisted selection;
- new physiological methods.

Eleven new cultivars were registered and released since 2000, out of which 4 in the last 5 years. Together they were already grown in 2012 on more than 57% of the total wheat area in Romania. The new cultivars are additions to a history of NARDI contribution to wheat production in Romania. For 30 years Fundulea cultivars have covered 1/2-2/3 of Romania's total wheat area. The cultivar Glosa is also registered in Hungary, Boema is registered in Turkey and the cultivar Izvor in Argentina.

Several other research results have been obtained in this project, such as:

- improved parents for Fusarium Head Blight resistance breeding;
- new parents for barley yellow dwarf virus resistance breeding;
- introgression of useful genes from rye using triticale as a bridge (for bunt and BYDV resistance, improved early vigor in seedlings, increased plant albedo);
- identification of a SSR marker associated with superior osmotic adjustment capacity in cv. Izvor
- parents for breeding to increase grain protein content, etc.

An estimation of the economic impact of just one successful released cultivar (Glosa) indicated that on the 300 000 ha area cultivated in 2010, an additional production of more than 60 000 t, worth about 10 million Euros was obtained, which is more than ten times the total expenses of breeding this cultivar.

Work in the frame of the same project resulted in 8 Triticale varieties registered, out of which the variety Titan was registered in Canada, France and Hungary, and variety Decor was registered in USA. Progress has also been achieved in improving winterhardiness and plant type in semidwarf winter durum wheat.

b) IMPROVING THE GENETIC BASIS OF SUNFLOWER CROP, THROUGH BREEDING NEW, COMPETITIVE HYBRIDS

Sunflower is the main oil crop in Romania. Sunflower breeding had a long tradition at NARDI. As due to the hybrids developed at this institute, Romania was the first country to grow sunflower hybrids commercially. Now the hybrid seed market is dominated by international breeding companies, but NARDI still possesses a niche of the market. Besides, the NARDI owns a very valuable germplasm, many of its inbred lines being used in hybrids jointly released worldwide by several private companies and NARDI. As a result, NARDI receives its share of significant royalties.

33 sunflower hybrids were released since the beginning of the breeding program and the most recently released ones show a significant improvement both in yield and oil content. NARDI bred hybrids and joint hybrids obtained with participation of NARDI inbred lines are registered and are grown in many countries, such as Spain, France, Italy, China, etc., Sources of genes for disease resistance have been identified, including genes transferred from related species.

Now the project concentrate on developing improved sunflower hybrids, resistant to diseases and herbicides and tolerant to drought, and on obtaining pre-basic seeds of own recent creations, for farmers specialized in producing commercial hybrid seed.

c) IMPROVING ATTRACTIVENESS AND PROFITABILITY OF LEGUME CROPS, BY BREEDING IMPROVED PEAS CULTIVARS.

Legumes can play an important role in sustainable agriculture, as they can allow reducing Nitrogen fertilizers for the crops following them in crop rotation. Additionally they are providers of valuable proteins, much needed for animal, and even direct human, nutrition. Peas, which is theoretical the grain legume most adapted to the continental climate almost disappeared from Romanian agriculture, because it is less profitable than other crops, especially since animal farming diminished in the last years, but also because of several problems, such as lodging, shattering and sterility caused by heat and drought.

This project aims at increasing the attractiveness and profitability of peas, by breeding lodging and shattering resistant cultivars, more tolerant to drought and heat. A new cultivar with improved performance was registered in 2012.

Winter peas cultivars with improved winterhardiness open a new perspective to increase yields by better using the moisture accumulated during the winter. Recently two winter peas cultivars have been submitted for official testing in view of registration.

d) PROMOTING THE CONSERVATIVE AGRICULTURE SYSTEM, BY SOLVING PROBLEMS RELATED TO ITS INTRODUCTION

Conservative agriculture, based on no-tillage and intelligent retention of a right quantity of plant residues on the field, is largely practiced in many countries and proved to be very efficient in reducing costs, protecting the environment and reducing emissions of greenhouse gases. However introduction of this agriculture system in Romania encountered resistance, partly because many farmers are reluctant to adopt radical changes in the farming system, but also because some problems can appear in specific soil and weather conditions.

First results obtained at NARDI demonstrated that yields obtained by applying the conservative agriculture were equal or higher than those obtained by applying the traditional system, while costs are significantly reduced and the effects on the environment are positive.

The project will continue to study the long term effects of conservative agriculture, will identify possible problems related to adopting this system while demonstrating and propagating this system to farmers.

e) IMPROVING PERFORMANCE OF ORGANIC FARMS BY BETTER MANAGEMENT PRACTICES

Organic agricultural products are gaining the preference of an increasing number of consumers. Romania is in a good position to provide such products to the internal and European market. However, yields obtained in organic agriculture are usually lower and even some aspects of quality (for example bread-making quality of wheat) are inferior to products obtained in traditional or intensive agriculture.

NARDI has developed research aiming at improved performance of organic farms, by creating a special research center for organic farming in the frame of the institute. By supplying scientific results and recommendations to organic farms NARDI will help in promoting this system and in improving the yield level and quality, as well as the economic results of organic farming.