Aurelia MUREȘAN (MARIAN)

Summary of the PhD thesis

Research on economic optimization of seed production in winter wheat in the Transylvanian counties

Scientific adviser
Prof. univ. dr. MIRCEA SAVATTI

CLUJ-NAPOCA
2012
Research on economic optimization of seed production in winter wheat in the Transylvanian counties

Keywords: certified seed, seed classes, cultivars, hybrids, counties, fertilization, efficiency, economy

The thesis is based on a survey in eleven counties in Transylvania, on demand and use of seed classes of winter wheat, the basic (B), certified seed 1 (SC1) and certified seed 2 (SC2), and also the economic effects of using them for obtaining commercial seed.

The increase in agricultural crop yields is largely determined by the quality of seeds used in sowing areas for consumption. Using high quality seed for sowing leads to expression in optimal culture conditions of full productive and quality potential of cultivars used in agriculture, as economically justifiable.

In the process of seed production, from choosing typical plant cultivars to ensuring full seed quantity, cultivars are subject to the influence of biological, economical, environmental and technological factors that can ultimately contribute to reduce their initial value. These influences can be largely prevented and eliminated by knowing the causes that generate them and by applying complex measures through the whole process of production, processing, preservation and selling of seeds, making the seed a real factor to increase agricultural production.

The studies regarding particular aspects of seed production, especially from the economic point of view, are relatively few. This fact has led us to consider appropriate to deal with this process, in terms of genetic, technological and economic issues, with special reference to winter wheat cultivars spread in culture, in some Transylvanian counties. Deepening the various aspects of the biological reaction of used cultivar seed classes and the influence of technological measures can elucidate the most effective measures in the ongoing maintenance of winter wheat and the importance of this activity in terms of rapid multiplication of winter wheat cultivars and maintaining their highest possible biological qualities, finally reflected by the amount of commercial seed obtained.
The production of quality seed of varieties and hybrids with a high biological value is an important link in the technological process for obtaining high, stable and quality yields.

Seed production is an institutionalized complex process, which aims:
- to obtain seeds capable of accurately reproducing the cultivar, having regard to all of its individual features;
- to obtain seeds of appropriate health, vigor and cultural value, according to current standards;
- to breed the necessary amount of material intended to be sown (or planted) in economic conditions.

Seed with high biological value should show a constant genetic and biological evidence, varietal and physical purity, and a high index of germinability and optimal health. Such seed can contribute to optimal expression of the entire productive potential of the cultivar.

On this basis it can be argued that generally researchers and growers try to obtain high and quality yields by sowing biological material with high genetic and cultural value (NEDELEA și MADOŞA, 2004; MADOŞA, 2005).

The methodology of seed production has a genetic background and represents stages or levels of the seed production process, as specified in relation to the reproduction mode and genetic features of the cultivar.

In seed production, a conservative selection is applied, stabilizing individual selection is fundamental methodological principle, applied methodology schemes following maintenance the genetic structure of the cultivar.

Even a valuable seed, over generations of multiplication it can lose initial production capacity, due to the influence of biological factors, as well as the ecological and technological ones.

Changing the genetic structure of a population is determined by the joint action of these factors, among which mention mutation, gene migration, natural selection, deviation of the reproduction mode, genetic drift, environmental
conditions, technologies employed, space isolation etc. (SAVATTI, 1983; SAVATTI şi colab., 2004).

The main factors mentioned, which weakens the cultivars genetic structure, acts as the interconnection, or separately. Mutations, gene migration and delayed segregation spur permanent variation of population and natural selection and genetic drift, through their combined or individual action, favors only certain genotypes and constantly changing the frequency of genes and genotypes, modifying the initial genetic structure, with significant negative economic consequences in the conservative breeding.

Outside factors may recall, biological depreciation of cultivars can be influenced by different technological measure, which overlapping natural selection action, whose effect was sometimes amplified. Among these measures are: sowing time, soil fertility, sowing density, harvest time and seed conditioning.

Creation of valuable biological forms and keeping them in an institutionalized process of seed production is an activity of great social and economic importance. They meet the needs of national and global economic development, now and in future.

Official definition of the cultivar, the meaning of Law 266/2002 regarding production, processing, quality control and certification, marketing of seeds and planting materials and plant variety registration, is the following: "Cutivar (variety) is a group of plants belonging to a botanical taxon of the lowest known rank".

Defining cultivar is based on the following criteria:

- **criterion of individuality, identity and distinctiveness**, by which cultivar is distinguished from another by one or more features that are specific, and can be defined or described, giving a certain feature (size, growing season, shape, seed color, etc.) likely to give appearance of new;

- **criterion of homogeneity or uniformity** takes into account the similarity of main features of all individuals forming cultivar (same size, same growing season, the same shape and color of seeds, etc.) except for a small number of atypical forms, taking into account the reproductive features;
- **stability criterion** refers to maintaining the identity and homogeneity properties after successive reproductions and at the end of each reproductive cycle.

Cultivar can be classified in terms of agriculture, botany and genetics.

Seed production is aimed at achieving basic stability character, respectively maintaining distinctibility and uniformity of that cultivar or hybrid after repeated multiplication. While the stability of self pollinated cultivars can be maintained relatively easily, if the specific methodologies for seed production are used, in the case of cross-fertilized cultivars uniformity is obtained more difficulty due to possible migration of genes and difficulties in maintaining the panmictic balance of the population (HAŞ, 2006).

Seed production is a basic component of agriculture aimed at ensuring the quality and quantity of seed for domestic needs and export availabilities (in Romanian cultivars registered abroad and the foreign multiplied in Romania) (HAŞ, 2006).

Seeds sold to farmers are the result of cooperation between several institutions, out of which the most important one is the Ministry of Agriculture and Rural Development. In this regard, the Ministry of Agriculture and Rural Development organized seed production according to different ecological areas, particularly for crops that require large amounts of seed for sowing per hectare, to reduce transportation costs.

Maintaining the genetic structure of cultivated cultivars is achieved through the maintenance process. This should contribute on the one hand to the maintenance of some biotypes providing variety performance, and on the other hand to eliminate the biotypes with negative features.

**Methods of seed producing**

Seed production requires a certain methodology for cultivars and another one for hybrids.

In the case of varieties, seed production has the following three stages:

- the basic seed production;
- the certified seed production;
The main classes of the base seed production are: typical plant choice field, field for biological purity maintenance, field for obtaining prebase I seed, field for obtaining prebase II seed and field for obtaining base seed. All this fields are obtained in research stations.

In the case of wheat cultivars seed production starts after homologation, with determination of the seed and surface quantities, conditioned by the requested needs and the spreading zone.

The aim of the all stages of seed production, listed below, is to maintain the type of cultivar by eliminating all inappropriate progenies and plants, using negative selection.

Romania presents 14.7 million hectares of agricultural area, from which only 10 million are occupied by arable land.

In 2008, total value of romanian agricultural production was 66.9 billion lei (increasing by 40% compared to previous year and 59.9 billion lei less compare to 2009 year). Value of agricultural production in 2010 was 64.4 billion lei, of which the value of crop production was 43.4 billion lei (67.5%), the animal one of 20.4 billion lei (31.6) and agricultural services amounted to 557.2 million lei (0.9%).

**Wheat crop in the agriculture of some Transylvanian counties**

Highlighting concerns about particular aspects of seed production and use in agricultural production, especially economic point of view, have been too little studied, defending the need to elucidate the complementary aspect of the topics addressed in order to be able to achieve this goal in the counties of Transylvania, is the need for characterization of Romanian realities of agriculture, from the restrictive and favorable aspects of this activity.

The major problems of romanian agriculture, restrictive ones, may be defined by the following:

- highly fragmented structure of farmland generate subsistence farms;
- the presence in rural area of a large proportion of the vulnerable population, in terms of meeting the agricultural European requirements;
- large fluctuations from year to year of agricultural production;
- the lack of valuable cultivars facilitates the introduction of EU cultivars, with negative economic implications;
- failures in providing agricultural seed material with high biological value (basic, certified 1 and 2);
- Romanian products do not always match the EU quality standards, becoming hard salable;
- technical and material conditions, represented by mechanization and chemicalization positioned Romania behind many European countries;
- external financing crucial to agriculture, is modest due to pressures on budget spending;
- poor orientation of banks in the financing of small farms;
- international financial crisis has an adverse effect on domestic agriculture;
- lack of specific strategies on agricultural reform, the reform should aim at supporting sustainable farm organization of agricultural production, organization of agricultural markets (trading rules and norms), pricing from producer to consumer.

With all the issues that adversely affect economic performance in agriculture, are limiting factors counter situations such as:

- Romania's privileged position in terms of economic resources (39.5% of the country is arable land);
- our soils are characterized by high fertility, supporting the development of competitive agriculture;
- attracting European funds in the Common Agricultural Policy (CAP) (the 2007-2013 benefit of 14.5 billion euros);
- local opportunities by applying regulations with positive effects in terms of stabilizing prices of agricultural products and their sale in the EU;
- development of dynamic competitiveness determinants, such as concentration of capital and operating land in viable units;
- increase of technical equipment and promotion of agri-, pedo- and hydroameliorative measures;
- development of market infrastructure and occupational diversification in rural areas;
- cereal crop is predominant in two thirds of arable land being on the 10th in the world, corn ranks second in Europe, sunflower fifth, eighth potato, which highlights the rapid development of agriculture and the rural economy (see tables 4.6.-4.10.).

Mentioned strategies should be the subject of a organic law, supporting agriculture to ensure reliability, stability and continuity of such measures.

Considered the most important crops, wheat in the conditions of our country show an alternation in terms of cultivated areas, but especially the production from year to year, mainly conditioned by climatic factors and modest financial endowments of small subsistence farms.

One of the conditions to boost performance of this culture is the use of sowing seeds with high cultural value, with a high biological purity, from the most competitive recommended cultivars.

The lack of serious research on the behavior of cultivars in the climatic conditions of Romania makes especially small businesses do not enjoy certain criteria on the biological value of the cultivars that are offered.

Certified seed requirement is estimated at an annual of 510-550 thousand tons, of which about 60% is obtained in the country.

The problem of production and use of wheat seed for commercial cultures is conditioned by structure of existing cultivars, the introduction of ISTIS unauthorized foreign cultivars to be grown increase disorientation and chaos in our existing seed market.

**Working method**

To achieve biological survey on the use of winter wheat classes in the 11 counties of Transylvania, one of the scheduled activities was the collection of socio-economic data from the areas studied to capture many economic issues that hinder or favor the development of winter wheat crop in the North-Western, Central and Western development regions.
Undertaken efforts have provided important qualitative and quantitative information which could synthesize relevant views for locating the optimum ways and technical applied development for conversion of wheat culture in Transylvania.

The data collected are based on official statistical sources and technical study of the 11 counties in Transylvania, as well as raids of documentary field for collecting information on seed production of wheat.

As a documentary support were prepared tables and graphs, which have structured information on:

- specific intake of wheat crop development set zones agriculture;
- total and average production per ha of winter wheat in covered counties and areas occupied by certified and uncertified seed;
- cultivated winter wheat cultivars and be subject to multiplication by biological categories;
- number of cultivars with high biological value and seed multipliers;
- wheat area occupied in 2008-2010, with certified seed;
- calculation of seed necessary per year, 2008-2010, from author seed to seed C1-C2;
- setting the indicators of economic efficiency of wheat seed culture in the environmental conditions of Transylvania counties, made on the analysis of realised production on different fertilization conditions, characteristic to the counties of mentioned ecological area;
- calculation of economic indicators for two biological categories of seed, basic (B) and certified seed (C1) used to setting seed and commercial crops. In this context, we studied calculating the rate of profit per hectare and expenses for each combination of fertilization, rate of profit per kilogram of seed, coupled with lack of fertilization and most favorable fertilization;
- evidence based on interpretation of the economics of winter wheat seed production, a comparison in terms of economic efficiency of this activity
in different ecological zones of Transylvania and a possible redistribution of superior classes seed production crop on their economic effectiveness;
- compare the economic efficiency of wheat crop obtained with certified and uncertified seed.

Economic efficiency of institutional seed classes production requires knowledge of seed necessary to be made of seed classes.

To prepare plan for seed production must be known following aspects:
- farms culture plan and cultivar/cultivars which should produce seed;
- planting rate (kg/ha) required for comercial crops, respectively for different classes of the seed production process;
- net seed yield (kg/ha) planned for the various biological categories. Net yield is obtained by reducing the gross yield of about 20-25%, deduction resulting from seed conditioning;
- reserve fund to be established for different categories of biological seed (table 5.5.)
- the average ear production, necessary to determine the number of progenies in selection field and the number of elite plants to be extracted.

Calculation of seed necessary for a particular biological classes is made by multiplying the area to be seeded with planting rate.

To determine the surface of seed lot we need to obtain that quantity of seed, the calculated seed requirements is divided by the net planned production.

In the selection field is important not determined area, but only the number of ears harvested from the seed can obtain to sow the field of pre-basic I (PB I). This is determined based upon the caracteristics of the cultivar under multiplication. Taking into account the number of cultivars grown in the 11 counties of Transylvania were made following averages: TKW (38 g), average number of grains in an ear (36) weighing about 1.4 g. On the obtained data seed requirements will be calculated as illustrated in table 5.6.

To illustrate the general economics of the winter wheat crop in the 11 counties in Transylvania were taken out:
- the cost price of a kilogram of wheat, respectively of the culture;
- average yield per hectare;
- areas sown with certified and uncertified seed;
- adding a bonus of 500 kg seed per hectare for each hectar resulting from uncertified seed;

Based on these elements, calculations aimed:
- total cost of sown areas;
- the total obtained yield;
- the total value of yield;
- net/total profit of sown hectares.

Setting indicators of economic efficiency of wheat seed culture was based on average production during the year 2008-2009, on different fertilization conditions, randomly chosen, obtained in the analyzed counties.

Fertilization variants, corresponding to different amounts of simple or complex fertilizers were applied:

- \( N_0P_0 \) – unfertilized variant;
- \( N_{50}P_0 \) – variant fertilized with 50 kg/ha ammonium nitrate;
- \( N_{50}P_{50} \) – variant fertilized with 250 kg/ha ammonium;
- \( N_{100}P_{100} \) – variant fertilized with 500 kg/ha ammonium nitrate.

Economic indicators were calculated for two categories of biological seed (Basic and Certified I) used to obtain seed C1, respectively commercial crop. Obtained data results are presented separately for the two mentioned biological categories.

**Aspects of agriculture in some Transylvanian counties**

In the counties of Transylvania differences occur on areas cultivated with wheat, the average obtained production caused by environmental factors, land orography and productive value of cultivars (see tables 5.7.-5.8.).

Depending on the constraints conditions the examined counties can be divided into two categories: favourable to winter wheat culture, such as Bihor, Alba, Mures, Covasna, Brasov, Cluj and less favorable Nasaud, Salaj, Hunedoara. All that
counties cover together about 8.8% of the cultivated area in the country, producing between 7-8 and 9.4% of total wheat production of Romania (2008-2010).

Development of appropriate production was conditioned by the process of high biological value seed production and their use in the commercial production process, as demonstrated by comparing yields and economic results in terms of crops sown with certified and uncertified seed.

The seed production was negatively influenced by the annual structure of wheat crop, varieties grown in Transylvania totaling over 50 cultivars, which has hampered the detection of valuable cultivars and fluidity of the production process of superior biological classes, from a year to another (see tables 5.11.-5.21.).

In the extremely volatile market capitalization price of wheat was more or less stable over the years, the chances of stable prices were negatively affected by the lack of opportunities for small producers to achieve production storage, purchasing inputs and profitable selling of wheat on domestic market.

Economic effects of an agricultural holding, regardless of its size, is given by the report by the output (harvesting energy) and input (introduced cultural energy).

In terms of net profit/ha, there was an increase in the annual amount of inputs used, with direct negative influence on economic index culture (see tables 5.23.-5.24.).

In the mentioned conditions in Bihor county, from the three analyzed years, only 2008 were found favorable for winter wheat crop, resulting in net income/ha in the case of certified and uncertified seed use to crop establishment, boosting production by providing bonus of 500 kg seed per hectare sown with uncertified seed shows an increase in net profit/ha and respectively the need to use certified seed in crop establishment.

In the whole sown area in the 2008-2010 period shows that lack of economic benefits that are determined mainly by low average yields/ha, especially in subsistence households, adverse weather conditions and lack of proper coordination of production and use programs of certified seeds, especially for Romanian cultivars, which had a share percentage of 62.2% from the total cultivated area.
Negative influence factors on net profit/ha have been increasing spending on crop inputs (30%) and lower production obtained price (see tables 5.25.-5.30.).

**Bistrița-Năsăud county**, the smallest county in the North-West region, is characterized by small subsistence farms.

In culture were used romanian cultivars that occupied an percentage area of 72.8%, of which Arieșan cultivar was 66.9%.

There was a decrease tendency of the sown areas, from 4956 ha to 3842 ha, accompanied by an obvious lack of concern in the use of certified seed.

In condition of a favorable climatic year (2008) net income/ha is almost zero, theoretical correction of unsued certified seed for comercial cultures production highlighted the possibility of achieving a net income of more than 300 lei/ha (see tables 5.31.-5.33.).

In **Sălaj county**, generalized system of subsistence agriculture has an impact on a lack of necessary measures to achieve appropriate productions (certified seed agrophytotechnical measures etc.), reflected in the acquisition in 2008-2010 of wheat average yields about 2000 kg/ha.

There were 13 varieties in culture, eight local, they occupied an area of 87.1% of the crop.

Certified seed used during the three years was very little, being done and used ten times less than the calculated requirement.

Leaving aside the social importance of wheat culture, economic and production data interpretation raises the question of profitability of wheat culture in this county (see tables 5.34-5.37.).

In **Cluj county** during the years 2008-2010 was performed an average yield close to 3000 kg/ha, exceeding the average of the country.

There were 11 varieties used, of which four local cultivars (Arieșan, Apullum, Dumbrava și Dropia), were found in 93.7% of sown area, dominant in all analyzed years was Arieșan cultivar.

Certified seed was provided in most of the main maintainer of the county SCDA Turda.
Economic benefits were obtained in 2008, negative results were not compensated for productions obtained in other years, due to the low recovery of seed, associated with excessive growth of annual inputs.

With a price recovery of about 1.0 lei/kg wheat crop could have significant benefits (see tables 5.38.-5.41.).

**Alba county** is 32.8% of the counties studied, characterized by a high proportion of small agricultural properties (99.8%).

Crop structure was defined by the existence in culture of 21 species including 13 native.

The largest proportion had cultivars Arieșan, Apullum and Dumbrava, with an area of 14,056 ha (75.3%), in 2008-2010 Arieșan cultivar occupied 61.4% of cultivated area.

A feature was the low insurance with certified seed, even if the average size in the three years was 19%, the statement is justified by the fact that there was only 11 cultivars with certified seed production, with annual continuity made without judgment.

Although economic results haven’t been beneficial, even in favorable 2008, the factual situation was influenced by the many small subsistence farms, incapable of sustained financial efforts to generate profitable production (see tables 5.42.-5.44.).

Although **Sibiu county** has smallest area cultivated with winter wheat in the analyzed counties, shows a downward trend in areas sown, although the average yield was 2800 kg/ha.

The structure of the area occupied by winter wheat was determined by cultivation of ten varieties: seven domestic and three foreign, 63.3% of the area was occupied by Romanian cultivars.

Provision of certified seed was poor, showing an obvious discrepancy in continuity of seed production from year to year, caused by poor possibility of recovery of produced seed.
Although in 2008 the economic benefits were realized in the favourable climatic conditions corresponding to an average yields over 3000 kg/ha, an acceptable recovery price of production, as well as inputs used in the next two years, despite good production per hectare, increasing inputs and decreasing value of wheat delivery price did not make possible the expected revenue.

With a production of about 3000 kg/ha (three-years average) only 1.0 leu/kg cost recovery of wheat could offset higher input and achieve 20-30% annual economic growth (see tables 5.45.-5.48.).

In Brasov county, unlike some Transylvanian counties, there was a trend of consolidation of agricultural lands and a doubling of the number of farms with legal personality.

There has been a three years average production (2008-2010) of 3042 kg/ha, using 13 cultivars in culture, five domestic and eight foreign.

The largest areas were planted with cultivars Transylvania, Arieșan, Apullum, Dumbrava (domestic), Alex and Renan (foreign).

There was a constant tendency to use certified seed crops and striving to achieve the annual continuation of this process.

In terms of economic benefit, 2008 year proved fast, unlike the 2009-2010 with less favorable climate, with an increase in investment costs and lower prices for recovery of production (see tables 5.49.-5.51.).

Considered as a basic producer of winter wheat in Transylvania, Mures county, due to objective conditions (rain, flooding), in the period 2008-2010 has the average yield only 2385 t/ha.

Cultivars structure defined by the cultivation of 14 cultivars, from which eight local, which totaled 88.6% of sown area.

Authorized economic agents have materialized activity by achieving a total quantity of certified seed of 1400 t, representing a rate of 17.4% for the total sown area.

Adverse conditions in the three analyzed years have made no realization of economic indicators.
It reaffirms the idea that under economic deficit of wheat crop, sowing only certified seed for the entire area, resulting in substantial reduction of economic scarcity.

If the price of recovery of production was about 0.80 lei/kg obtained deficit would have been annihilated (see tables 5.52.-5.54.).

**Harghita county** achieved an average production per unit area in 2008-2010, to 3333 kg with a structure consisting of 12 cultivars, from which eight were Romanian.

Although provided with certified seed area did not exceed 7.4%, the largest share was made with Arieșan and Apullum cultivars.

In terms of economic only in 2008 were realized substantial net profits/ha average of 2008-2010 were found negative differences in both calculated variants, but not particularly large.

If the average price of a kg of wheat seed was calculated at 0.70 lei, the establishing costs of the cultivated areas were zero, in the second option (giving bonuses) could achieve income of 324 lei/ha (see tables 5.55.-5.57.).

The main agricultural aspect of **Covasna county** is the subsistence small and medium farms, with an average production of winter wheat for 2575 kg/ha.

Wheat crop structure was determined by the existence of ten varieties of which Apullum and Arieșan have 86.5% share of sown areas.

The increasing dynamics of cultivated areas have Csardas, Magdalena (Hungarian varieties) and Renan (French one).

The seed production process was characterized by major interest of achieving the certified seed in the county, which allowed in the 2009 and 2010 a assurance from 18.7 to 20.7% with certified seed of cultivated areas.

In 2008, only certified seed sowing of the total area cultivated, would have, theoretically, the net income/ha of 250 lei.

Negative results are combined result of relatively modest average annual production, increasing crop establishment costs and the low cost of recovery of production (see tables 5.58.-5.60.).
In Hunedoara county agriculture has not been a core economic sector, being rather characterized by subsistence farming. Climatic conditions, also not very favourable, have led to an average production of 2,680 kg/ha.

Crop structure was defined by the existence of eight cultivars, six native ones and two French; the prevalent variety in culture was Arieșan, with 64.3% of the sown area.

In a county with generally reduced areas cultivated with wheat, it was possible, in all the three experimental years, in most cases, to provide certified seed that covered 15.3% of the total sown area.

There occurs a similar situation to the one in Covasna, in the sense that the need for certified seed was proved in this county, too. Economic profit is only obtained in the theoretical version of granting the production bonus (500 kg/ha) (see 5.61.-5.63. tables).

In terms of efficiency of wheat seed culture it has been found that for seed classes B (base), the economic indicators provide a direct proportionality between the rate of profit per hectare, the production and the expenses for each combination of fertilizers, situation which is identical to seed class SC I (certified seed I).

The comparative data show the importance of producing and using seed with high biological value in institutionalised production phases, as it will reflect its biological and economic value in the commercial cultures as well (see tables 5.64.-5.72.).