SUMMARY

PhD thesis: „*RESEARCH ON THE FIELD CROPS ASSORTMENT DIVERSIFICATION THROUGH GRAIN LEGUMES CROPS GROWING IN THE NORTH DOBRUDJA CONDITIONS*"". Engineer Antonio-Romeo O. LOMBARDI

Keywords: *grain legumes; Tulcea County, Macin-Smardan polder; soybean - yields and crop quality (protein and fat); Romanian and imported varieties; sowing dates, row spacing and densities; weed, pests and diseases control; economic efficiency indicators to soybean, field pea, field beans, lupine.*

People involved in scientific agricultural and nutritional research, and in agricultural practice states that grain legumes are plants with great importance and compete with cereals by the value of food and feed and are superior to them because of the role they have in the crop rotation by helping to increase soil fertility and as favorable preceding crop for other field crops. Unfortunately, these plants do not occupy sufficient acreages due to certain deficiencies. Thus, grain legumes crops productions are unsteady and efforts are needed to improve performance of biological material and of growing technologies for these crops in order to compete better with cereals; grain legumes are less competitive in the fight against weeds, some are susceptible to dropping and shaking mature seeds, water stress, pest and disease attack.

This may explain the fact that, in 2013, provisions of the new Common Agricultural Policy include as a priority promoting protein crops - including grain legumes, to cover a larger proportion of the protein consumption from own production ("*The Environmental Role of Protein Crops*", 2013). The idea of approaching this theme for doctoral thesis occurred in this context of the new Common Agricultural Policy which aims to promote protein crops. In addition, in 2012 intervened the "Donau Soja" initiative, based on a document signed by agricultural ministers from 18 European countries, whose main target is to support the cultivation of (non-GM) conventional soybean, including soybean organic crop.

Grain legumes are a vital food resource that contributes to satisfying human food diets in different parts of the world. Legumes are a rich source of proteins, accounting for between 20% and 40% of the seeds from different grain legumes species. Proteins are rich in essential amino acids, especially lysine, threonine, isoleucine, leucine, phenylalanine and valine. Their association with cereal grains in the diet that are deficient in lysine, but rich in methionine, solves this problem.

Agronomic importance of grain legumes is special: the crops are fully mechanized; most species leaves the field early, leaving it enriched in organic matter and nitrogen, free of weeds, without crop residues, wet enough to be worked early and in good condition; they are good previous crops for most other crops and excellent previous crop to winter wheat; thanks very early harvest, there is possibility to sown after some grain legumes (peas, beans) of succeeding crops.

In Romania, "the assortment of grain legumes covered, over time, about 10 species, of some economic importance (pea, field beans, soybean, chick pea, lentils), some species grown on small areas and of regional significance (e.g., broad beans, groundnuts, cowpeas, white lupine, yellow lupine, Lathirus). The acreages sown with grain legumes have been quite volatile over the last century in Romania: about 99 thou ha in 1938; 167 thou ha in 1950; 194 thou ha in 1963; 672 thou ha in 1987; 250

thou ha in 1992; 125 thou ha in 2013 (of which, 67 thou ha with soybean, 21 ha with field beans, 30 thou ha with field pea)" (Gh.V.Roman, 2015).

Experiments of Macin-Smârdan polder were initiated to better know the biology and harvest formation mechanisms of grain legumes, and the adaptability of soybean, field pea and field beans to the North Dobrudja conditions, to get information on some elements of growing technology - the parameters for culture setting, and on economic efficiency indicators - information that is missing in the area. It may be noted that the data obtained by us represent the first experimental results in Macin-Smardan polder, Macin area, in the north of Dobrudja, which gives them a special value.

The thesis is divided into 9 chapters, plus introduction, conclusions and recommendations, bibliography with 207 titles and a list of 35 websites, and contains 88 tables and 63 figures.

Chapter I, entitled: "*The importance of grain legumes, essential components of crop rotations, sources of food, industrial raw materials and energy*" summarizes information on: the assortment of grain legumes with global and Romanian significance; evolution of growing acreages and yields, resulting in their restriction of culture, and the share it holds soybean, with over 50% of the global acreage and ¾ of global production, followed by peanuts, beans, chick pea and cowpeas; chemical composition and quality of the harvest of high quality seeds, by the presence of essential amino acids (lysine, threonine, leucine, etc.) and the importance of soybean and peanuts as oleaginous species; special attention is paid to legumes agronomic importance, underlying the need to increase soil fertility as ameliorating plant and very favorable previous crop for most other crops.

Follow **Chapter II** - "*Bibliographic study on grain legumes of economic importance for Romania*", a documentary synthesis rich in information, designed to substantiate the thesis option to address this group of plants. There are treated, in turn, the 3 major grain legumes species cultivated in Romania - soybean, field pea, field beans. At soybean, after general information (history, utilization), shows that there is a rich biological material in use as the basis for genetic breeding, and emphasizes that the varieties are classified according to the requirements of temperature and photoperiod and it insist on maturity groups important for Europe and Romania (groups 000-II). It shows the range of varieties and his evolution in Romania since the first experiments with soybean, until the current selection (the first varieties coming from Central Europe; introducing the Russian varieties< the period of American and Canadian varieties dominance; the remarkable genetic and breeding work for Romanian varieties creation in Fundulea Research Institute and Turda Research Station< the current assortment of varieties that contain a significant share of Romanian and Serbian varieties).

The text on sowing parameters insists on the recommendations based on information from other geographical growing areas, but most of Romanian experiments. With attention is developed pest control issues with a focus on weed control: discussion begins with fighting only by hoeing, then first herbicide use (trifluralin + metribuzin); waiver of herbicides applied before seeding with deep incorporation and generalization of herbicides applied in pre-emergency and post-emergency; period in which was used Round-Up Ready technology. They are presented pests that attack soybean, but points out that only the systematic attack of red spider mite require each year chemical interventions. Similarly, soybeans are

attacking of different diseases and control measures are described, but only in certain situations diseases attack require special measures to combat it. The chapter continues in the same manner by presenting specific problems for field pea and field beans.

Natural conditions of the area of testing are presented in **Chapter III** ("*The natural framewotk in the research area*"), comprising a complex characterization of Macin-Smardan polder and of the Macin Experimental Field. The experiments were placed on a molic-calcic aluviosoil, with medium favourability, and through an accurate and irrigated technology, it can provide favorable conditions for field crops. Experimental years were different in terms of weather conditions: the first two years (2009-2010 and 2010-2011) were closer to normal in terms of temperature and were rich in rainfall (503.4 mm, and respectively 621.4 mm, compared to 445.0 mm multiannual average), and the next 2 years (2012-2013 and 2013-2014) were warmest (annual average temperature exceeded the normal by 1^{o}C) and precipitations exceeded 600 mm in the 3rd experimental year and were close to normal in the fourth year. Weather conditions in the agricultural year 2011-2012 were quite bad and led to calamity of soybean crops.

Chapter IV - "*Materials and research methods*", begins with information on the purpose and objectives of the research for the thesis (analyzing the situation of grain legumes crops in Tulcea County and the nature and technology potential of the region to expand the study results; the study of a range of species and varieties of grain legumes, on morphological, productivity, yield quality and economic efficiency of the crops). In the Macin Experimental Field were organized in 2009-2014, seven field experiments: two comparative cultures with soybean varieties (11 Romanian varieties; 17 imported varieties); three experiments with sowing parameters (dates, row spacing and planting densities) on two soybean varieties; an experiment with measures to combat weeds in soybean crop; an experiment with varieties of field pea, field beans and lupine. On these experiments it was organized a comprehensive program of observations and biometric measurements of the morphological features of plants and of productivity components, seed production and crop quality (expressed as protein and lipid content). The experimental results were statistically analyzed by calculating averages, analysis of variance and regression analysis.

Of special interest is **Chapter V**, entitled "*Results of the study on grain legumes growing status in Tulcea County*" which provides an overview of the natural and socio-economic frame of the agricultural activities in Tulcea County, and it is envisaged the perspective of research results dissemination and expansion to other holdings in Tulcea County, but also in neighboring counties. The chapter includes data on grain legumes growing in the county, resulting in considerable fluctuation of the areas from year to year: for soybean, from 853 ha to 16,348 ha; 8,000 ha in the period 1985-1992; below these levels in the next period and return over 5,000 ha in the years 2013 and 2014. The average yields fluctuated much, but were around 1,170 kg grains / ha on average, over 1,600 kg / ha in 7 years and under 500 kg / ha in 3 years. The presentation contains detailed analysis of the data resulting from legumes species important for this county (soybean, field pea, field beans), for which are discussed evolution in cultivated areas, average yields and total production achieved in the county since 1975. For each of three

species are listed information, accompanied by maps, on farms in area cultivating legumes and their distribution in the county. In the final part of the chapter summarizes the results of a study for the period 2005-2012, the situation of grain legumes seed lots held in the county; these plots are small and with fluctuating acreages, depending on the interest of seeds producing companies.

Chapter VI, entitled "*Research results with an assortment of Romanian soybean varieties*" includes data on morphological characteristics and grain productions, annual data and as average over 4 years, of which emerges as a general conclusion, the good quality of tested biologic material. In the most favorable year 2010, average production of the experiment was 4,267.9 kg / ha, and yields have exceeded 5,000 kg / ha in the most productive varieties - Triumph, PS1012, PS1020. These results demonstrate that the experimental area provides favorable conditions for growing soybeans. On average over 4 years, the most productive varieties were Onix, Oana F, Diamant, who produced more then 3,000 kg / ha. Synthesizing the results on morphological characteristics as average per maturity groups have highlighted some features specific for each maturity groups in the years 2010 and 2013; in average over four years, evidently late varieties were more productive: 3,868.04 kg / ha on average in group I, versus 2,648,1 kg / ha in group 000, 3,056.5 kg / ha in group 00 and 3,297.5 kg / ha to group 0. Analyzes of yield quality illustrated protein content of 36.0% on average, and 37.0 to 37.4% for the varieties Triumf and Oana F, in 2013, respectively 33.3% on average, and below 35% in all varieties, in 2014; these levels must be considered in comparison with the requirements for protein content over 35.0% of processing companies.

Chapter VII is designed similarly and present "*Research results with an assortment of imported soybean varieties*", which identified the special value of the tested varieties and their adaptability to growing conditions in the area. Among the imported varieties the most productive was Sponsor, which produced 4,521.2 kg seeds / ha on average four years, and 4,802.5 kg / ha in the year 2013. With high yields were noted varieties Venerra (4,384.2 kg / ha), PR92B63 (4,271.1 kg / ha), NS Trijumf (4,235.2 kg / ha) too. The imported varieties had protein contents of 36.1% on average and 39.7 to 40.7%, at the varieties PR92B63 and Sigalia, in 2013, respectively 33.0% in average and below 35.0% for all varieties, in 2014. The correlations between morphological characteristics and maturity groups on the one hand and grains production and maturity groups, on the other hand, were evident.

In **Chapter VIII**, "*The results of research on some components of soybean growing technology*" are presented and discussed data obtained in experiments with sowing parameters and measures to combat pests in soybean crop. These studies showed that soybean should be sown in northern Dobrudja, namely in Macin-Smardan polder, at 45 cm / 70 cm or 70 cm between rows, with 60 g.s. / m^2, in decades II and III of April and late sowing lead to sharp production declines.

Variants of weed control measures with herbicides have shown their effectiveness in weed control close to hoeing, achieving sharp decline of weeds. The best results have been obtained by cultivating 3 times, or by application of herbicides gliphosat or S-metolachlor in pre-emergency, and imazamox and quizalofop-p-ethil (Pulsar+Leopard+Silwet), in post-emergency, and the weed control was conducted in a ratio of 82- 87%, and the yields were 3,356-4,025 kg of grains / ha.

Particular attention was paid to **Chapter IX**, entitled "*Research on the economic efficiency of grain legumes growing in Northern Dobrudja conditions*." The issue of economic efficiency of agricultural production activities are essential and the development of any productive activity is contingent on expenditures recovery and getting profit. In this regard, results from own research and personal experience accumulated in agricultural production activity were synthesized in technological estimates for soybean, field pea and field beans. In preparing such estimates were used endowment with machines, equipment and materials used by farms in the area, with material resources and expertise, applying moderne technologies. In soybean, resulted expenses in the amount of 2,468.2 lei / ha for agricultural works and expenses with materials worth 1,302.5 lei / ha, which led to a total volume of expenses of 4,072.3 lei/ha.

On this basis, were calculated indicators of economic efficiency for experiments with Romanian and imported soybean varieties, which resulted in that is achieved profit at more than 3,000 kg grains / ha, and at 4,000 kg / ha they are particularly profitable crops. In the technological estimates for field pea, the total expenses are of 3,095.9 lei / ha, of which 1,600.8 lei / ha for agricultural works and 1,258 lei / ha for materials, which concluded that at the current recovery price of 1,200 lei / t, a crop of pea can become profitable by productions over 3,000 kg of seeds / ha. By comparison, field beans, spending totaled 5,667.0 lei / ha, of which 2,882.2 lei / ha for agricultural works and 2,365.0 lei / ha for materials and profitable production at current recovery price of 5,000 lei / t can be obtained at more than 1,500 kg seeds / ha.