# ABSTRACT

**PhD thesis**

**Title:** Optimization of the economic efficiency of mineral and organic fertilization for wheat, barley and sugar beet on chromic preluvosol from Moara Domneasca

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**Keywords**: nitrogen, economic efficiency, organic fertilization, mineral fertilization, wheat, barley, profit, production, crop rotation, sugar beet

The PhD thesis "OPTIMIZATION OF THE ECONOMIC EFFICIENCY OF MINERAL AND ORGANIC FERTILIZATION FOR WHEAT, BARLEY AND SUGAR BEET ON CHROMIC PRELUVOSOL FROM MOARA DOMNEASCA" presents the results of the researches from the long-standing experience with rotation of organic and chemical fertilizers, that was established in the agricultural year 1991/1992, under stationary conditions, in the Experimental Didactic Field of the Faculty of Agriculture, within UASVM Bucharest, from the Moara Domnească farm, Ilfov County. I continued my research in 2014-2017, after almost 22 years when the effect of organic fertilizers (manure, straw, parcels and sugar beet leaves) gained stability, sustainability and balance in rotation.

The paper was structured into ten chapters as follows:

**In Chapter 1**, entitled "GENERAL CONSIDERATIONS ON THE IMPORTANCE OF OPTIMIZATION OF AGRICULTURAL CROPS FERTILIZATION", there are briefly presented the two types of fertilization, organic and mineral, the importance, and their role in the development of the crop plants, the sources or the ways of obtaining them.

The most commonly used organic fertilizer used on both farm and an individual farm is manure. It is regarded as a universal fertilizer, complete with regard to the nutrient mix, which is applicable to all soil types and to all crop plants.

Chemical or mineral fertilizers, obtained through physical and chemical processes, are designed to supplement the need for nutrients that are indispensable for a harmonious growth and high plant productivity.

**Chapter 2,** entitled "CULTIVATION TECHNOLOGIES OF WHEAT, BARLEY AND SUGAR BEET", deals with aspects of wheat, barley and sugar beet culture technologies in our country. Culture technologies have as parameters the location of crops, the application of fertilizers, soil works, seed and sowing, weed control, pests, pests and irrigation. All these links need to be linked and part of sustainable agriculture.

Also in this chapter are discussed aspects related to the role of organic and mineral fertilization for the agricultural crops studied.

**Chapter 3,** entitled "CURRENT KNOWLEDGE OF OPTIMIZATION OF TECHNOLOGY IN WHEAT, BARLEY AND SUGAR BEET WITH REFERENCE TO MINERAL AND ORGANIC NITROGEN", presents the current stage of knowledge regarding the optimization of wheat, barley and sugar beet technology with reference to organic and mineral fertilization and the results obtained by the scientific research.

**Chapter 4,** entitled "THE NATURAL AND INSTITUTIONAL FRAMEWORK OF RESEARCH", presents the geographic, pedological and climatic characteristics of the research area (the Moara Domnească, Ilfov County), the territory that is part of the Romanian Plain relief, the Vlăsia Plain Subdivision.

The three years of experimentation were analyzed in terms of precipitation and temperatures, their influence on the results of research being significant.

**Chapter 5,** entitled “METHOD OF RESEARCH", presents the aim and objectives of the researches undertaken, the experimental variants and the way of calculation and interpretation of the resulting values. The general problem of the doctoral thesis pursued the influence of the organic and mineral fertilization on the obtained productions and the increase of the economic efficiency. The specific objectives pursued were the determination of the level of production (production achieved), of the physical indices for determining its quality (mass of 1000 grains and the hectolitric mass), and the determination of the main indicators for establishing the economic efficiency. The crop rotation was 3 years: 1. Wheat, 2. Barley, 3. Sugar beet. From the point of view of the organization, the experience is bifactorial type 3x5 based on the subdivision parcel method, in 3 repetitions, containing factor A - organic fertilization and factor B - mineral fertilization. Factor A had the following graduations: $a_1$- organic non-fertilized, $a_2$ - manure and $a_3$ - vegetable debris and $N_{50}$. Factor B graduations were different depending on the mineral nitrogen requirement of the crops in the rotation. For autumn

wheat cultures the graduations were as follows: $b_1$ - mineral fertilized, $b_2$ -$N_{60}$, $b_3$-$N_{100}$, $b_4$-$N_{150}$ and $b_5$-$N_{200}$. For autumn barley cultures the graduations were as follows: $b_1$ - mineral unfertilized, $b_2$ -$N_{60}$, $b_3$-$N_{100}$, $b_4$-$N_{140}$ and b -N180. For sugar beet cultivation, the graduations were as follows: $b_1$ - mineral fertilized, $b_2$ - $N_{80}$, $b_3$ - $N_{120}$, $b_4$ - $N_{180}$ and $b_5$ - $N_{240}$. The estimated economic efficiency indicators were the following: production increase, production increase value, specific production increase to 1kg of active substance, total revenue, total expenses, profit and profit rate.

**Chapter 6,** titled "THE INFLUENCE OF ORGANIC AND MINERAL FERTILIZATION ON WHEAT CROP" presents the results of research on autumn wheat crops. Thus, for each of the three years of research, the results obtained, respectively the production for each experimental variant (3 graduations of organic fertilization and 5 graduations of mineral fertilization), the mass of 1000 grains and the hectolitric mass were presented.

The results obtained showed that the agricultural year 2016-2017 was the most favorable, the yields obtained from organic fertilization varied between 3565 kg/ha and 4322 kg/ha for the variant $a_3b_1$ - 40 t/ha beet leaves and beet sugar and $N_{50}$, this being the optimal variant that ensures the highest increase in production. In the case of mineral fertilization, the application of a $N_{150}$ dose on an organic agro fond of 40 t/ha of sugar beet leaves and sugar beets and $N_{50}$ provided a yield of 8257 kg/ha, a production increase of 3935 kg/ha over the value the unfertilized witness.

The average production of the years of the 2014-2017 experience revealed the organic fertilization variant in the absence of mineral fertilization $a_3$ (40 t/ha leaves and sugar beet leaves and $N_{50}$) which provided a production of 4095 kg/ha, ie an increase of production of 667 kg/ha compared to the non-fertilized control. The optimal variant was $a_3b_4$ (40 t/ha sugar beet leaves and beets and $N_{50}$ - $N_{150}$) at which the average yield was 8072 kg/ha with a production increase of 3977 kg/ha. The average values obtained for the hectolitric mass show that this physical index of production quality increases with mineral fertilization and organic fertilization from 79,98 kg / hl ($a_1b_1$) to 81,79 kg / hl ($a_3b_5$) and the mass of 1000 grains decreases with mineral fertilization from 49,51g ($a_3b_1$) to 46,79g ($a_1b_5$).

**In chapters 7** entitled "THE INFLUENCE OF ORGANIC AND MINERAL FERTILIZATION ON BARLEY CROP" are presented the results obtained for the barley culture on the same structure as wheat.

Organic fertilization in the absence of mineral fertilization significantly influences the production, respectively its increase from the control value from 3846 kg/ha to 4316 kg/ha for variant $a_2b_1$ and 4646 kg/ha for variant $a_3b_1$.

Mineral nitrogen fertilization in the absence of organic fertilization also significantly influences the production of autumn barley, which produces an increase in production compared to the control, ranging from 36% to 75%, the yields varied between 3846 kg/ha for the unfertilized variant at 6160 kg/ha for mineral fertilizer variant $a_1b_3$, respectively 6729 kg/ha for variant $a_1b_5$.

The combination of mineral and organic fertilization determines barley production has a significant influence in all variants, so the recorded increases are between 1575 kg/ha and 2643 kg/ha for the retention of 30 t/ha of manure and between 1559 kg/ha and 2724 kg/ha for 5 t/ha wheat straw and $N_{50}$.

The average values obtained for hectolitric mass show that this physical index of production quality increases with mineral and organic fertilization from 61,98 kg / hl ($a_1b_1$) to 65,91 kg / hl ($a_1b_4$) and the mass of 1000 grains decreases with mineral fertilization from 42,92 g ($a_3b_1$) to 39,93 g ($a_2b_5$).

Largest production is obtained for the organic fertilized variant with 5 t / ha of wheat straw and $N_{50}$ and mineral fertilized with $N_{100}$ (7540 kg/ha) and the $N_{180}$ graduation produces lower yields for organic fertilizer variants.

**In chapters 8** entitled "INFLUENCE OF ORGANIC AND MINERAL FERTILIZATION ON SUGAR BEET CULTURE" are presented the results obtained regarding the production obtained for all experimental variants in the three years of experience but also the average of the years of experience.

The average production of the years of research 2014-2017 is influenced by organic fertilization and the optimal variant is the variant $a_2$ – 30 t/ha manure which produces 4820 kg/ha production increase compared to the organic fertilizer variant a1. Also, the average production of the research years 2014-2017 is significantly influenced by mineral fertilization, so production increases once the mineral nitrogen doses increase from 27780 kg/ha to 38530 kg/ha;

The influence of mineral and organic fertilization on the average production of the research years is significant, thus the production of the manure with 30 t/ha of manure increases with the mineral nitrogen from 33,6 t/ha ($N_0$) to 43,66 t/ha ($N_{180}$) and on the agrofond with 5 t/ha

barley straw + $N_{50}$ the production increases with the mineral nitrogen from 30,22 t / ha ($N_0$) to 41,98 t / ha ($N_{180}$). At the $N_{240}$ dose for both organic fertilization agglomerations, the production decreases compared to the $N_{180}$ dose.

The optimal variant for sugar beet production is $a_2b_4$ variant (30 t/ha manure and $N_{180}$) which produces a production of 43.66 t/ha.

**In Chapter 9**, entitled "INDICATORS OF THE ECONOMIC EFFICIENCY OF ORGANIC AND MINERAL FERTILIZATION CALCULATED FOR CROPS OF AUTUMN, WHEAT AND SUGAR", there are presented a series of indicators of economic efficiency based on the results obtained calculated for each crop: the production increase, the value of the production increase, the production increase to 1 kg SA, the income, the total expenses, the profit and the profit rate.

The production increase, the value of the production increase, the total income and the total expenses increase with the organic and mineral fertilization graduations for the three cultures of the experience except for the $N_{240}$ gradients that lead to decreases in these economic indicators.

Profit and profit ratios determine the optimal fertilization variant in terms of economic efficiency that does not necessarily coincide with the optimal production variant.

**Chapter 10**, "CONCLUSIONS", synthesizes the results obtained during the experimentation period.

Applying organic fertilization in the absence of mineral fertilization leads to small increases in production and low economic efficiency for all three crops.

The combination of organic fertilization with mineral fertilization results in a significant increase in production and high values of economic efficiency indicators up to the fertilization stages $b_4$ ($N_{150}$ for wheat, $N_{140}$ for barley, $N_{180}$ for sugar beet), or $b_3$ (wheat $N_{100}$ and barley, $N_{120}$ for beet) in some cases. Graduation $b_5$ ($N_{180}$ for barley, $N_{200}$ for wheat and $N_{240}$ for sugar beet) is not technically and economically justified.

For autumn wheat crop the optimal production variant is the $a_3b_4$ variant (organic fertilized with 40 t/ha beet leaves and beet parcels and $N_{50}$ and mineral fertilized with $N_{150}$) and the economically optimal variant is $a_2b_4$ (retention of 30 t / ha of manure and $N_{150}$).

For autumn barley crop, the optimal production variant is the $a_3b_4$ variant (organic fertilized with 5 t / ha wheat straw and $N_{50}$ and mineral fertilized with $N_{140}$) and the

economically optimal variant is $a_3b_3$ (organic fertilized with 5 t/ha wheat straw and $N_{50}$ and mineral fertilizer with $N_{100}$)

For sugar beet cultivation, the optimal production variant is the a2b4 variant (organic fertilized with 30 t/ha of manure and mineral fertilizer with $N_{180}$) and the economically optimal variant is $a_3b_3$ (organic fertilized with 5 t/ha barley straw and $N_{50}$ and mineral fertilizer with $N_{120}$).