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Research Article

Agricultural Production, Soil Quality and Fertilizer Used in Braila County, Romania

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Abstract

The article proposes a research of the agricultural potential according to the soil qualities in Braila County, the South-East region of Romania. Fertilizer application corrects soil composition, resulting in a qualitative and quantitative increase in crops. Fertilization based on soil composition and precursor plants has the role of balancing the quantities of fertilizers and of achieving maximum production potential. Specialized data on soil composition, quantity of fertilizer and production were collected from the official database and national statistics as well as from agricultural scientific articles. The results of the research have led to a correlation between the soil, production and the amount of fertilizer used, the production is reduced when the soil characteristics are known.

Keywords: fertilisers, soil, production

Introduction

In the agricultural technologies for crops, the soil occupies an important place, being the main source of plant nutrients and support for the development of the root system. The soil must provide plants with the elements they need to grow and develop normally. To have profitable and quality crops in agriculture, we need to know not only the type of soil, its composition, the micro and macro elements of the soil, but also the texture of the soil. There are at least 16 elements known to be essential for plant growth. Carbon (C), Hydrogen (H), and Oxygen (O) are derived from carbon dioxide (CO2) and water (H2O). Nitrogen (N), Phosphorus (P), Potassium (K), Sulphur (S), Calcium (Ca), Magnesium (Mg), Boron (B), Chlorine(Cl), Copper (Cu), Iron (Fe), Manganese (Mn), Molybdenum (Mo) and Zinc (Zn) are normally derived from the soil in the form of inorganic salts. Ninety-four to 99.5 per cent of fresh plant material is made up of carbon, hydrogen and oxygen. The other

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nutrients make up the remaining 0.5 to 6.0 per cent (McKenzie, 1998). The macro elements Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, and Sulphur are indispensable to plants; all these elements are extracted from the soil through root absorption. The microelements of the soil can be found in smaller quantities (Manganese, Copper, Molybdenum, Zinc etc.), but their effects on plant metabolism are very important. Knowing the composition of the soil, the specialists could prepare appropriate fertilisation plans for different crops. The soil, seed, technology, machinery and irrigation are used in order to optimize the ratio between the costs incurred and the value of the production, (Băcanu et al., 2017). Both the deficiency and the excess in nutrients can lead to a significant decrease of the crop production.

Material and Methods

The information on the agricultural land on which chemical fertilisers were applied and the amount of fertilisers used to correct the soil composition (chemical or natural) were collected from the National Institute of Statistics (INS) database. Data on the soil in Brăila County has been selected from the documentation of the National Research and Development Institute for Pedology, Agrochemistry and Environmental Protection (ICPA) Brăila. In some cases, media information from scientific journals or specialist journals was also used. The collected data were statistically taken and represented graphically, the results are analysed and commented.

Elements of Pedology

Romania has 29 types of soil altogether, which, depending on the general characteristics relevant to the growth and development of plants and the secondary morphogenetic peculiarities, are classified in 12 classes (SRTS-2012). Each soil class has between 1-5 genetic types; a total of 29 (Tarau et al., 2014). In Romania the soil categories, according to the scale of research, are divided into: large-scale mapping and detailed mapping; medium scale mapping and small scale mapping, respectively.

Pedology mapping represents a complex activity consisting of 3 important stages: the preparation stage, which consists of collecting all the materials and collecting the information on the region (preparation stage); the field stage, including achieving profiles and sampling soil; performing tests and interpreting the results. Soil sampling is done with special probes, following procedures for mapping specific in the soil studies. The samples collected shall be preserved in clean plastic containers and based on the working protocol, the composite sample shall be obtained. Soil tests are made in specialized accredited laboratories. The result of the tests includes information on: the content of humus; the soil texture; Soil pH and Electrical Conductivity (EC), Main nutrients (nitrogen, phosphorus and potassium) and secondary ones (calcium, magnesium, iron etc.).

The use of soil tests can help to determine the status of plant available nutrients to develop fertilizer recommendations to achieve optimum crop production. Knowing the type, texture, pH value and mineral content of the soil, we can avoid excessive fertiliser application, resulting in an optimisation of the production technologies with important effects in reducing the final price of the agricultural product. Agrochemical soil testing is a key element to soil nutrient management and provides a farmer with an estimate of the amount of fertilizer nutrients needed to supplement those in the soil.

The distribution of soils in the main geographical areas of Romania is shown in Figure 1.

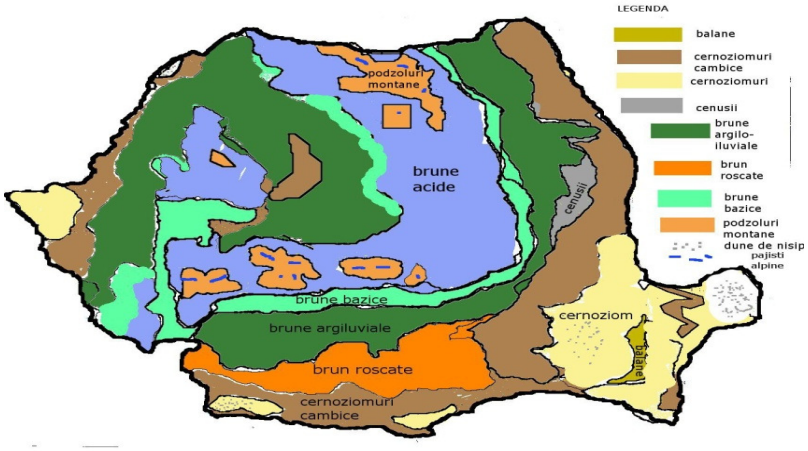

Fig. 1: Distribution of soils in the territory of Romania
Source: EcoFerma (2014)

Romania can be considered as a real collection of soils, because on the national territory, most soils in Europe and many of the world soils can be found (Puiu et al., 1983).

Soils in Braila County

In order to classify the soils in Brăila County, the specialists in the field performed pedology mapping, dividing the soils in terms of quality, based on the 5 classes of ratings into: 1st class - very good with ratings between 81-100 points, 2nd class - good with rating of 61-80 points, 3rd class – average with ratings between 41-60 points, 4th class - low with ratings between 21-40 points and the 5th class - very poor with grades of 0-20 points. The agrochemical mapping of the soil is done by means of soil profiles that are of three types: main, secondary and control or surveys.

Fertilisation of soil with fertilisers

Fertilizer refers to any compound that contains one or more chemical elements, organic or inorganic, natural or synthetic, that is placed on or incorporated into the soil or applied directly onto plants to achieve normal growth. The main supply sources of plant nutrients include organic manures, plant residues, biological nitrogen fixation and commercial inorganic fertilizers. Fertilisers used in the agriculture are mineral or organic substances, simple or compound whether natural or synthesised which are applied in solid or liquid form in the soil on its surface or on the plant to supplement the nutrient requirement improving the conditions for growing and developing agricultural plants, facilitating the decomposition of organic residues, increasing the microbiological activity and raising the general soil fertility condition in order to increase the crop production from a quantitative and qualitative point of view and with a minimum or no disturbance of the ecological environment (Madjar and Davidescu, 2008). The European Commission has announced stricter rules on the use of fertilisers, in particular regarding the maximum admissible content of certain elements in chemical fertilisers. The type of fertiliser, the amount or the time of application varies from one region to another depending on a complex of biotic and abiotic factors. Although a modern agriculture aimed at high productivity involves the use of these agricultural treatments, the quantities must be carefully metered, since in case of excesses, the effects obtained will contrary to expectations. The exponential increase in the use of the fertiliser can be an explanation for the rapid expansion of agricultural productivity in the post-war period. Despite the high cost of fertiliser

acquisition, crop fertilisation is motivated by the fact that in their absence, productivity is reduced and the quality of the harvests is weaker (Stanciu, 2016). Application of nitrogen fertilisers is one of the ways to replace the nitrogen removed from the soil when harvesting the crops. Precautions for the administration of nitrogenous fertilisers which are very active in the soil are linked to the fact that they can be easily washed by rainwater or irrigation. To prevent these losses, these fertilisers will be administered when they are needed. In most cases, not all of the nitrogen is administered in the sowing or growing period, the administration is done in stages, depending on the periods of evolution of the plants (Stanciu, 2017a).

The widespread use of nitrogen can lead to additional sources of waste and the pollution of underground water sources, and excessive use of fertilisers has led to soil pollution in the form of nitrogen deposition or the development of non-native or invasive plant species. In some sub-Saharan African areas, where the sub-use of fertilisers did not result in the extraction of nutrients from the soil which were not complemented with external sources of fertilisers, an important degradation of the soil and a significant reduction of agricultural yields were found. In the case of wheat crops, the administration of nitrogen fertilisers can contribute to doubling or even tripling the production. Applying one kilogram of fertiliser of active substance generates an average production increase of 10-15 kg of grain, which can even exceed 25 kg of grain. The expert advice on the amount of nitrogen fertiliser available for wheat crops depends on the type of soil: 90-100 kg / hectare on luvic and brown luvic soils; 80-90 kg / ha on illuvial-clay and cambic or sandy alluvial soils; 150-200 kg / ha on wet ground Chernozems, 140-160 kg / hectare on marshy soils and vertisols, respectively (Agricultural News, 2013).

Using crop rotation adapted to local conditions, mulching and manure are alternatives to nitrogen fertilisers, the former two are able to restore the proportion of nitrogen in the soil. Some plants, especially the group of legumes (soybeans, peas), alfalfa, etc., based on symbiosis processes with root-based organisms, can fix the nitrogen from the air into the soil, reducing the deficiency in this element (Stanciu, 2017b). The new Romanian regulations on organic fertilisers limit to 170 kg of nitrogen active substance / ha, representing the maximum amount of nitrogen that can be administered by applying organic fertilisers to agricultural land within one year. Farmers must follow a fertilisation plan, complying with the maximum nitrogen standards for small farms, or on the basis of an agrochemical study for irrigated / intensive farming / large scale farms.

Compared with the Western European countries, the amount of fertilisers used by farmers on agricultural land in Romania is moderate, mainly due to high prices. The chemical industry in Romania produces large quantities of chemical fertilisers, especially for export. The areas of chemical fertilisers distributed by regions in the national agricultural sector during the period 2010-2016 are shown in Figure 2.

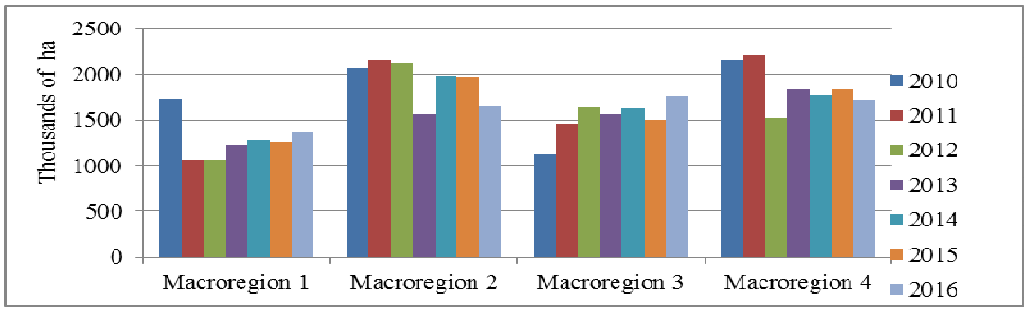

Fig. 2: The area of grounds on which chemical fertilisers were applied

The source: Author, by using INS (2018)

According to graphical data, an interesting evolution of the distribution of chemical fertilisers at the national level can be observed during the analysed period. The dynamics of fertiliser distribution is not a uniform at the national level, with significant differences between regions and from one year to the next (figure 3).

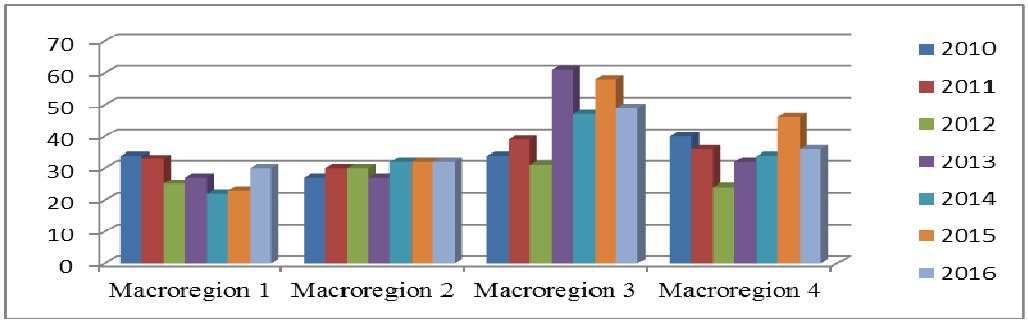

Fig. 3: Quantity of chemical fertilisers in active substance (kg/ ha) for the macro regions

The source: Author, by using INS (2018)

Thus, in the Macroregion 2, in which the research is carried out, about 140,951 tons of chemical fertilisers with nitrogen, phosphorus and potassium were distributed in 2016 in the two North-East development regions (Bacău, Botoşani, Iaşi, Neamţ, Suceava, Vaslui Counties) and in the South-East regions (Brăila, Buzău, Constanţa, Galaţi, Tulcea, Vrancea). The periods 2010-2012 and 2014-2016 are characterized by an increase in the quantities distributed, the values registered in 2016 was about 5% higher than the maximum recorded in 2012. The area is characterized by relatively balanced developments in soil fertilisation without significant differences in 2010-2016. Significant increases in chemical fertilised areas can be seen in the Macroregion 4 in 2010 and 2015, after a sharp decline in 2010-2012. The Macroregion 1 is characterized by the lowest volume of fertiliser volumes distributed over the period under review, with a steady decline in 2010-2015. The Macro-region 3 occupies the second position in the national top of the total quantity of agricultural fertilisers used at the national level (figure 4).

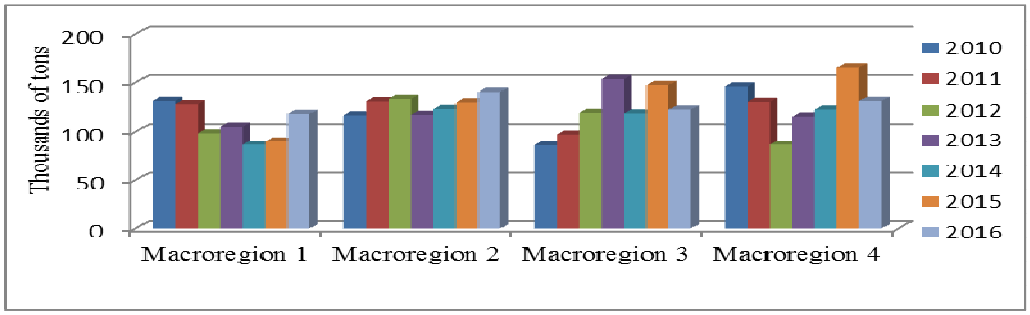

Fig. 4: The quantity of chemical fertilisers for regions and years (in tonnes of active substance)

The source: Author, by using INS (2018)

Soil fertility is given by its ability to provide the necessary conditions for plant growth and development by accumulating vegetation factors (light, water, air, heat, nutrients and biological activity) which requires that conditions be ensured for these factors to be used in sufficient quantities (Madjar and Davidescu, 2009). The chemical fertilizers can be broadly classified into: nitrogen, phosphorus, and potassium fertilizers. A straight fertilizer contains only one of the nutrients. A compound fertilizer contains two or more nutrients. A complex fertilizer is formed by mixing ingredients that react chemically, as opposed to a mechanical mixture of two or more fertilizers. A low analysis fertilizer product contains a low percentage of nutrients, usually 30 per cent or less and a high analysis fertilizer contains more than 30 per cent. The quality of the harvested crops is also determined by the quality of the genetic material (seed), the type of soil, the agricultural technologies applied, the necessary technical and material basis (machinery, fertilisers, pesticides, irrigation) or the quality of the human resource in agriculture (qualifications, information, research and innovation of the farmer) (Băcanu et al., 2017). At the level of Brăila County, the areas on which chemical fertilisers with nitrogen, phosphorus and potassium were applied in the analysed period ranged between 210 and 240 thousand hectares (Figure 5).

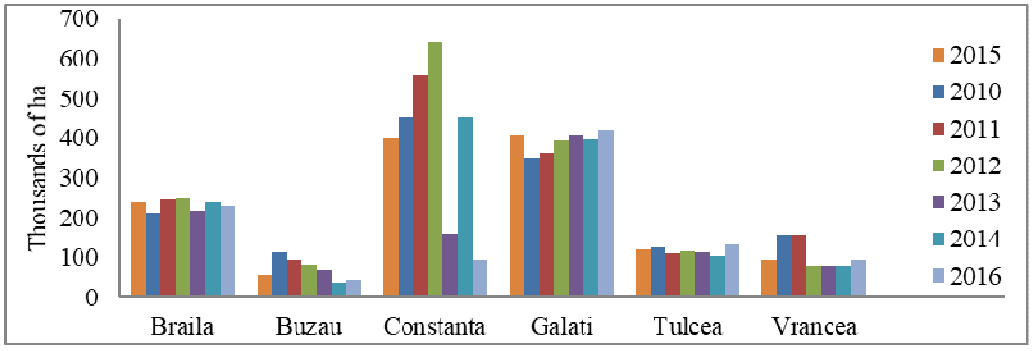

Fig. 5: The areas of plots in the South-Eastern region on which chemical Fertilisers were applied

Source: Author, by using INS (2018)

The use of chemical fertilisers in the South-East Region and Braila County

At the level of the SE Region, in absolute value, Constanta County recorded the largest quantity of chemical fertilisers with nitrogen, phosphorus and potassium applied in 2011 and 2012 (an absolute value of about 35 thousand tonnes / year), but had a significant reduction in 2016, to a minimum value of 5 thousand tonnes). Brăila was situated near Galati County, the last position was occupied by Tulcea County which also has a smaller agricultural area.
The year 2016 brought about a doubling of the amount of fertilisers distributed in Brăila County (Figure 6).

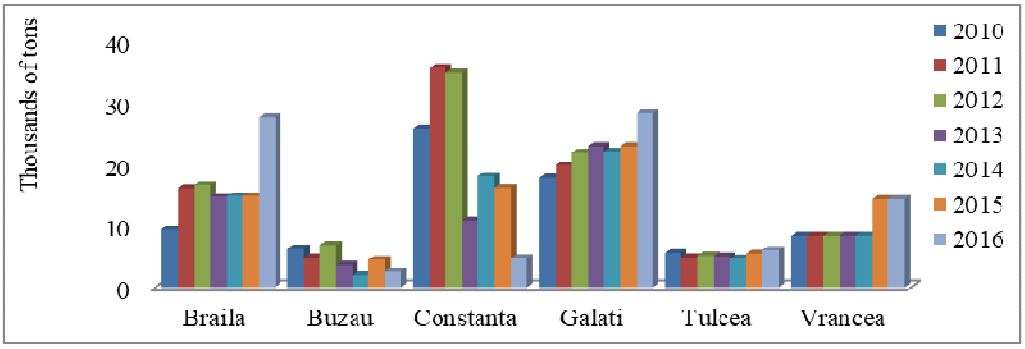

Fig. 6: The quantity of fertilisers used in the South-East region, for each county (tonnes of active substance)

Source: Author, by using NIS (2018)

Natural fertilisers include livestock and poultry manure (fresh or fermented) as well as liquid manure, peat, algae that decompose slowly and have a long-lasting effect. The amount of fertiliser, expressed in kg of active substance / ha, is distributed on agricultural areas of Brăila County, oscillated between 13 kg/ ha in 2016 and 55 kg / ha in 2015 (table 1).

Table 1: Quantity of fertilisers distributed on the agricultural area of Braila (kg active substance / ha)

Year	Macro region 2	Brăila County
2010	27	55
2011	30	43
2012	30	43
2013	27	41
2014	32	41
2015	32	41
2016	32	13

Source: Author, by using NIS (2018)

According to the data presented in figure 8, we can see the increase of the quantities of chemical fertilisers by categories of nutrients used in 2016 on the lands in Brăila County, in absolute value. Thus, if 5237 tonnes of nitrogen-based fertilisers were used in 2010, the quantity used in the year 2016 was three times higher, reaching the value of 15,899 tonnes of active substance.

The distribution of phosphate fertilisers also showed a positive evolution during the analysed period, reaching 11,329 tonnes of active substance in 2016. Compared with the reference year 2010 (4173 tonnes

administered), the quantities were 2.5 times higher. The smallest quantities of fertilisers were recorded in potassium-based ones, administered in quantities between 369 tonnes of active substance in 2016 and 1512 in 2012.

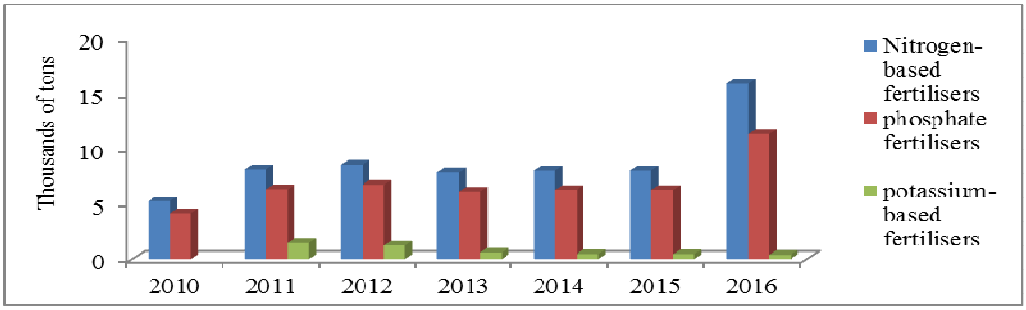

Fig. 8: Chemical fertilisers used in the agriculture of Brăila County (tonnes of active substance)

The source: Author, by using INS (2018) data

The data show a significant national reduction in the amount of chemical fertilisers in agriculture. The reduction is due to the strong decline of the national production. The chemical sector in Romania registered the largest deficit in the international goods trade in 2015, exporting products worth EUR 1.6 billion which on imports of EUR 5.6 billion led to a deficit of EUR 4 billion. Three of the largest companies in the chemical industry (GHCL Upsom, Oltchim and Amonil) were declared bankrupt or insolvent. The year 2015 is also the last year in which NIS published data for this sector (NIS, 2018).

Conclusions

The South-East Region of Romania is characterized by varieties with agricultural potential. Modern technologies, genetic material and rational application of fertilizers lead to maximum yields. Fertilizer management has a positive effect on the growth and development of the root system of plants. The quality of the soil can be remedied or improved by using fertilizers and modifications, but also by crop rotation. For maximum production potential, simple or compound chemical fertilizers are used depending on soil characteristics. A compound fertilizer contains two or more nutrients.

The key factors to consider when establishing a crop are: soil type, soil (pH), soil fertilizer stock and precursor plant. Deficiency or excess of fertilizers adversely affects the development of biochemical and physical processes, as well as the normal development of plants. At the county level, the largest quantities of chemicals were nitrogen-based, covering the need for grain crops and generating production increases.

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