EVALUATION OF NUTRIENT CONTENT IN PEA CROP FROM MUNTENI ORGANIC FARM – GALAȚI COUNTY, ROMANIA

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Abstract
Organic farming is less environmentally damaging agriculture that seeks strategies to avoid the use of hazardous chemicals that have a negative impact on soil micro-organisms, crops, animals and humans. The aim of this work is to find ways of capturing and fixing biological nitrogen, acquiring P and Fe as well as other essential elements. Leguminous plants play an important role in soil fertilization, high solubilization capacity for phosphates enrich the soil in nitrogen, high organic matter content and high uptake capacity for nutrients from heavy soluble compounds. The organic farm in Munteni commune, Galati county, cultivated autumn and spring peas to fix atmospheric nitrogen in the soil (pH 5.9-6.5) with the help of specific bacteria. The pH value favors the accumulation of nitrates in the soil but the results obtained do not exceed the maximum admissible concentration (130 mg/Kg). The total nitrogen content is between 0.162% and 0.042%, a medium content but which decreases on the soil profile (medium texture) by leaching. The forms of nitrogen assimilable by green plants nitrate and ammonium nitrogen in the soil solution were within normal limits (maximum 20 mg/kg). The use of cover crops can become an alternative to chemical fertilizers, but the supply of phosphorus and microelements remains low in the soil.

Key words: ecological, total nitrogen, nitrates, legumes

Excessive and improper application of chemical fertilizers, pesticides, herbicides and improper irrigation water as well as intensive tillage can over time become major sources of pollution with a negative impact on environmental quality. Out of a desire and a need to protect ourselves from these negative effects, organic farming has emerged, with the aim of respecting natural and environmental factors and involving agri-food products. The techniques used in organic farming are adapted according to resources, soil and climate conditions and local traditions (German R.N. *et al*, 2016).

This paper presents an overview of the methods for evaluating nutrients, especially nitrogen, in pea crops (autumn and spring) from the organic farm in Munteni commune, Galati county. Leguminous plants play a very important role in soil fertilization, they have a high solubilizing capacity for phosphates, especially in an accessible form. Nitrogen-fixing bacteria with which plants live in symbiosis assimilate free nitrogen. (Muller B, 2016). Atmospheric nitrogen reaches the soil via gas exchange and rainwater. Researchers at Cornell University -USA are looking for ways to develop more efficient cover crops as well as strategies to fix and measure nitrogen

The forms of nitrogen that can be assimilated by green plants are ammoniacal nitrogen (valence -3) and nitrate (valence +5) which come from organic matter through the mineralization process. The transition from one valence state to another is determined by microbiological conditions in the soil and environmental factors. The organic form of nitrogen becomes readily available to plants, having a slow and prolonged action for successor plants (Therond O. *et al*, 2016).

Bacterial activity is supported by a neutral pH and a normal content of phosphorus, boron and molybdenum. Optimal growing and climatic conditions are also highlighted, as well as the introduction of disease and pest resistance genes into the genome of crop plants. The technologies used depend on soil and climate conditions, existing resources and local traditions (Jităreanu G. *et al*, 2020).

Specific organic farming practices include crop rotation, making use of existing resources, using animal manure from nearby farms, using green mass from previous crops and limiting pesticides and herbicides. Natural processes, such

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as lightning storms, lightning storms, whereby atmospheric nitrogen is converted first to ammonia and then to nitrates, after which it is deposited on the soil by precipitation, are increasingly used (Ahada C.P.S., Suthar S., 2018)

Nitrates are less prone to precipitation and adsorption due to increased solubility. Therefore, it is difficult to be removed from water and the exclusion rate of nitrates increases with increasing pH value from 6.0 to 7.5 (Emmerson M. *et al*, 2016)

Organic farming practices maintain a proper balance and save natural resources. For example, to restore soil fertility, non-synthetic materials (green manure and manure) are used, the recycling process is encouraged and the use of genetic diversity of species in the area is used (Ayub R. *et al*, 2019)

MATERIAL AND METHOD

The Munteni Galati farm is located in Tecuci, Galati county, latitude 45 0 57′ north, longitude 270 24′ east. The field phase was carried out in august-september and march. Soil samples were harvested agrochemically at a depth of 0-20 cm after the spring and autumn pea crops. The plot has uneven ground where surface erosion by water and clogging occurs. From a pedological point of view, the soil profile was carried out to a depth of 130 cm with samples taken every 20 cm.

In the laboratory the soil samples were dried, wetted and analyzed in terms of reaction and texture, humus, accessible phosphorus and potassium, essential microelements, total nitrogen and mineral nitrogen content (nitric, nitrite and ammonium) were determined. The pH of the samples was analyzed in an aqueous suspension in a soil/water ratio of 1:2.5 and determined potentiometrically using a combined glass-calomel electrode; -determination and measurement of mobile phosphorus and soluble potassium content was carried out by extraction in an ammonium acetate-lactate solution according to the Egner-Riehm-Domingo method.

The determination of phosphorus was carried out colorimetrically and the determination of potassium content was read by atomic absorption spectrometer; the accessible content of microelements was carried out by extraction in EDTA-ammonium acetate solution at pH=7.0(Lăcătușu *et al,* 1987) and the determination of mobile contents of zinc, copper, iron and manganese by atomic absorption spectrometer AAS 700. Determination of total nitrogen content in soils was done by the Kjeldahl method, which involves the wet oxidation process by releasing it from organic compounds, and ammonium is released in the presence of sodium hydroxide and separated by distillation.

The Bremner method was used for the determination of mineral nitrogen. Exchangeable ammonium, nitrite and nitrate are determined in a 2n potassium chloride or potassium sulphate solution. The determination is carried out by distillation with water vapor in three aliquots from the soil extract - the exchangeable ammonium (N-NH4+) is determined directly from the soil extract in the presence of magnesium oxide; - the sum N-(NH4++NO2-+NO3-) is determined in the same extract in the presence of Devarda alloy and magnesium oxide; - and the sum N-(NH_4^+ + NO_3^-) is pretreated with sulphamic acid and determined in the same way as the other two fractions.

Particle size analysis was carried out by the classical Kacinski method by differential treatment of the samples with or without carbonates and by pipetting the grain size fractions (coarse sand, fine sand, dust, colloidal clay and physical clay) with a Kubiena pipette. Determination of organic carbon and estimation of humus content in soils was carried out by the 1n potassium dichromate wet oxidation method and titrimetric determination according to Walkley-Black in modification after Gogoașă.

RESULTS AND DISCUSSIONS

The principles on which organic farming is based are universal, but the techniques used are adapted according to existing resources and local traditions. The chemical analyses carried out for the company S.C. Oprea SRL in Munteni commune, Galati county, on the soil plots where autumn and spring peas were grown, show that there are small differences between the two crops (*Table 1*). The soil suitable for pea crops are those with a medium texture (*Table 2*), with a neutral reaction and a high content of phosphorus, calcium and potassium. Peas do not react to the application of nitrogen fertilizers and do not tolerate high moisture, thus denitrification occurs, which is influenced by the pH value and soil texture.

Table 1

Chemical analysis of the two plots covered by pea crops

No crt.	Analysis name	Autumn peas	Spring peas
1	pH	5.9	6.5
2	Total nitrogen	0,147 %	0,111 %
3	Humus	2.87 %	2.14 %
4	Accessible zinc	2.7 ppm	0.87 ppm
5	Accessible copper	0.57 ppm	0.47 ppm
6	Accessible manganese	11.1 ppm	9.1 ppm
7	Accessible iron	9.93 ppm	7.21 ppm

Soil reaction is important because it influences the mobility and accessibility of nutrients in the soil, and the solubility of both ions needed for plant nutrition and those that can release ions that can become toxic to plants over

time depends on the pH value. In the present case the soil reaction is weakly acidic, with a clay-sandstone (LN) texture only in depth, with a low phosphorus content and a medium content of microelements, with a nutrient balance effect with respect to nitrogen with implications for crop quality.

Table 2

Middle soil profile texture (LL= medium clay and LN= sandy-clay)

Type	Coarse Sand %	Fine Sand %	Dust %	Colloidal Clay %	Physical Clay %
A	-	45.4	23.1	31.5	43.4
A	2.9	48.0	21.4	27.7	37.1
A	4.1	48.4	19.7	27.8	36.8
A	2.1	49.1	21.4	27.4	39.0
AC	1.7	58.4	15.4	24.5	36.5
Ck	2.8	62.8	16.5	17.9	25.9

Nitrogen content can be assessed in terms of the percentage of total nitrogen or the nitrogen index which is closely related to humus content. It can be seen that soil fertility is conditioned by the presence of organic matter and *figure 1* shows the evolution of nutrient content in the autumn and spring pea crop. It is shown that higher values are obtained for the autumn crop than for the spring crop due to optimal temperature and adequate moisture.

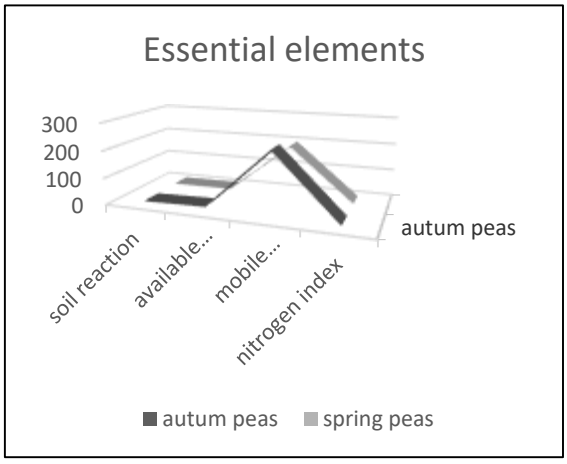

Figure 1. **Macroelement content in autumn and spring pea crop**

In soils where assimilable nitrogen is present in high amounts, the penetration of bacteria into the roots is slowed down, nodule formation is interrupted and the nitrogen fixation process is no longer valid. High nitrate levels endanger the environment, crop quality and human health.

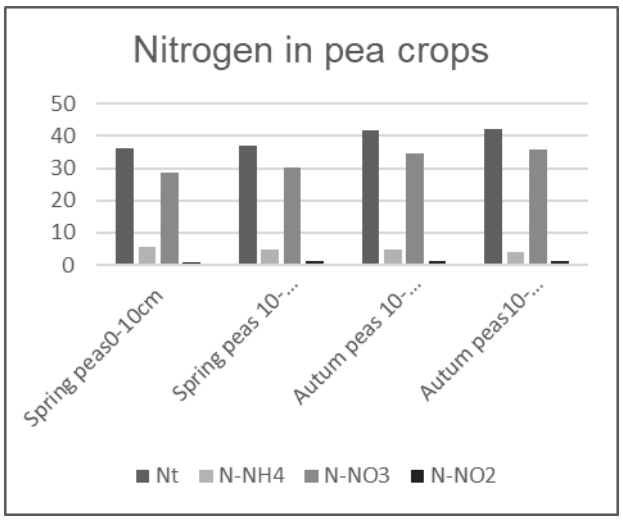

Figure 2. **Total and mineral nitrogen in autumn and spring pea crops**

The analyses in *figure 2* revealed that although the total amount of nitrogen remains unchanged in both crops, the stocks of the various forms of nitrogen are constantly changing. The ratio of nitrate to ammonium in the soil solution is found to be different. In spring the ratio is in favor of ammonium ($N\text{-}NH_4^+$) and in autumn it is in favor of the nitrate form ($N\text{-}NO_3^-$). Nitrite ($N\text{-}NO_2$) is rapidly oxidized to nitrate by soil micro-organisms.

During the growing season, soil nitrate concentration can vary greatly, as it comes from biochemical oxidation of the ammonia form. Nitrates are an essential source of nitrogen for plants. Most of the nitrates absorbed into the body come from vegetables (70%), water (20%), fresh meat (10%) and most nitrates accumulate in roots. Soil nitrogen is accumulated from the reserve that already exists in the soil, nitrogen from organic and mineral fertilizers, nitrogen fixed by bacteria and nitrogen from plant residues. Nitrogen in the soil is accumulated from the reserve that already exists in the soil, nitrogen from organic and mineral fertilizers, nitrogen fixed by bacteria and nitrogen resulting from plant residues. Nitrogen losses from the soil occur through leaching, volatilization, extraction with harvest and denitrification.

Plant growth can be limited by a low content of essential macro- and micro-nutrients, which is also the case on this organic farm in Galati county.

CONCLUSIONS

The main objective of organic farming is to protect the biosphere and natural resources.

The results highlight the safety of organic crops, which try to have a less harmful impact on the environment. They frequently use the natural resources existing in the soil, and legumes (peas,

beans, soya, clover, alfalfa) fix nitrogen thanks to bacteria that are able to synthesize nitrogen from the atmosphere.

The study generates a set of data on the forms of nitrogen and its fluctuations in an organic crop, which differ from species to species. Soil fertility is conditioned by the presence of organic matter.

The use of cover crops does not allow farmers to know the exact amount of nitrogen supplied to the soil. The timing of measurements is important because nitrogen fixation changes as plants grow. Insufficient nitrogen leads to stunted plant growth, and too much leads to plant sensitization and exposure to disease. Nitrogen deficiency is due to natural factors such as erosion, scouring, denitrification, leaching. (Bommarco R, Kleijn D, Potts SG 2013)

Macro-elements have an essential plastic role with implications for crop quality and micro-elements have an enzymatic role with essential metabolic implications.

Organic farming aims at long-term sustainable agricultural development (Smith and Lampkin, 2019) and contributes to improving the sustainability of food systems (Muller *et al*., 2000).

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