CONVERSION AND DYNAMIC REBALANCING PERIOD OF SOIL FERTILITY FOR ECOLOGICAL AGRICULTURAL SYSTEMS

PERIOADA DE CONVERSIE SI REECHILIBRAREA DINAMICĂ A FERTILITĂȚII SOLULUI PENTRU SISTEMELE DE AGRICULTURĂ ECOLOGICĂ

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Abstract: *The goal of the studies and research was to test the contribution of organic fertilisers to the dynamic rebalancing process of soil fertility for the conversion to an ecological agriculture system. In order to achieve our goals, we set field trials within which we tested the impact of an organic fertiliser at different rates (manure: 40, 60, and 80 t/ha) on the regime of soil nutrients and on the rebalancing of soil fertility. There is a lot of research going on in the field, but there are no concrete climate and soil conditions to do it; therefore we need to approach this direction too in the Timisoara area. Research results are favourable and they are readily applicable for a proper conversion to ecological agricultural systems.*

Rezumat: *Scopul studiilor şi cercetărilor a fost de a testa aportul îngrăşămintelor organice în procesul de reechilibrare dinamică a fertilităţii solului pentru conversia la un sistem de agricultură ecologică. Pentru realizarea obiecti-velor de cercetare, am organizat experienţe de câmp în cadrul cărora s-a testat influenţa unui îngrăşământ organic în diferite doze (gunoi de grajd: 40, 60 şi 80 t/ha) asupra regimului elementelor nutritive din sol şi a modului de reechilibrare a fertilităţii solului. În domeniu există multiple cercetări, dar condiţiile concrete de climă şi sol impun o abordare în această direcţie şi în arealul de la Timişoara. Rezultatele cercetărilor sunt favorabile şi găsesc aplicabilitate imediată ca recomandare pentru conversia la sistemele agricole ecologice.*

Key words*: soil fertility, organic fertilisers, ecological agriculture systems, conversion period, soil fertility dynamics*
Cuvinte cheie*: fertilitatea solului, îngrăşăminte organice, sisteme de agricultură ecologică, perioadă de conversie, dinamica fertilităţii solului*

INTRODUCTION

Conventional agricultural systems suppose high levels of production factors in order to reach the designed performance. This is why fertilisers, and particularly mineral fertilisers, are used at high rates to support the intensiveness of the ecological agricultural systems.

The new trends in alternative agricultural systems ensuring quality food with environmental protection are more and more promoted both in Europe and in other areas of the world. Romania is also part of this project, and there is a legislation framework and interest in the promotion and development of ecological agriculture systems.

The conversion from conventional agricultural systems to ecological agricultural systems implies a series of measures to be taken for the adaptation of the agro-ecosystem to the new parameters of functioning (13). During the conversion period, one of the main issues to be dealt with is the one related to plant nutrition (1, 2, 9, and 12).

The passage from intensive mineral fertilisation to organic fertilisation should be done in the conditions of a new balancing of the dynamics of soil nutrients so that the crops in the new agricultural system benefit from a balanced and sufficient nutrition (7, 9, and 12).

This is why we have tested the influence of fertilising with organic fertilisers at different rates on the main agro-chemical features with a view to re-establish the balance of soil fertility in supporting sustainable ecological agricultural systems.

MATERIAL AND METHOD

Research concerning the rebalancing of soil fertility by using organic fertilisers was carried out within the Didactic Station of the Agricultural and Veterinary University of the Banat in Timisoara, on a cambic phaeosiom, between 2003 and 2005.

To do so, we used organic fertilisers (animal manure) at rates of 40 t/ha, 60 t/ha, and 80 t/ha, together with a control variant, not fertilised, and a variant fertilised with mineral fertilisers at rates that, in other researches, proved to be the most favourable for wheat and maize crops.

RESULTS AND DISCUSSION

To point out the way organic fertilisers act in the remaking and rebalancing of soil fertility we started from academic data concerning the content and availability of nutrients in animal manure.

The average content of nutrients of the fertilisers we used was 0.5% N, 0.25% P_2O_5 and 0.6% K_2O. Literature points out that about 20-30% of the nutrients are available in the 1st year of application, 40-60% in the 2nd year of application, and 10-30% in the 3rd year of application (2, 3, 4, 5, 7, and 10).

In the process of conversion from conventional agricultural systems to ecological agricultural systems, the present legislation (13) stipulates a period of conversion of 2 years in the case of annual crops and of 3 years in the case of perennial crops.

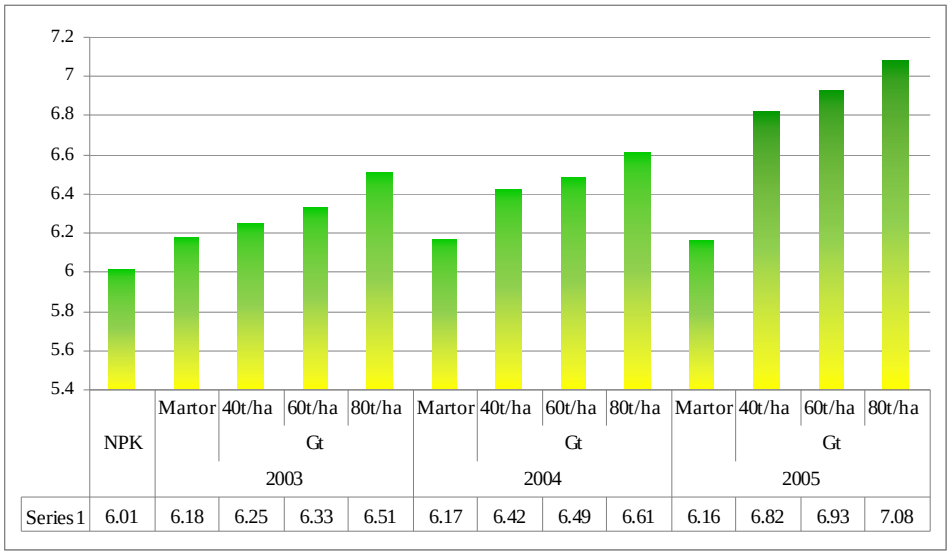
Soil fertility is one of the objectives in remaking and rebalancing during the conversion period. As a basic feature of soil in agricultural production, fertility is a feature that has formed and balanced in time on the ground of energetic inputs susceptible of being converted into nutrients accessible to the plants. The level and the speed of the transfer of nutrients between the two systems – soil and plants – is the soil fertility level (4).

In the case of mineral fertilisation, the availability and accessibility of nutrients is rapid as a result of the high speed of solubility of the fertilisers, which denotes high speeds of rebalancing the balance of nutrients in the soil-plant system.

Organic fertilisers can ensure high levels of nutrients through high rates of fertilisers applied per area unit, but the speed of accessibility of the nutrients is much lower, as it depends on the processes of decomposition and transformation of the manure in the soil. As a result, fertilisation with these resources asks for another working strategy for the effects to be cumulative and to effective progressively, taking into account the different degree of accessibility of the nutrients in the organic fertilisers.

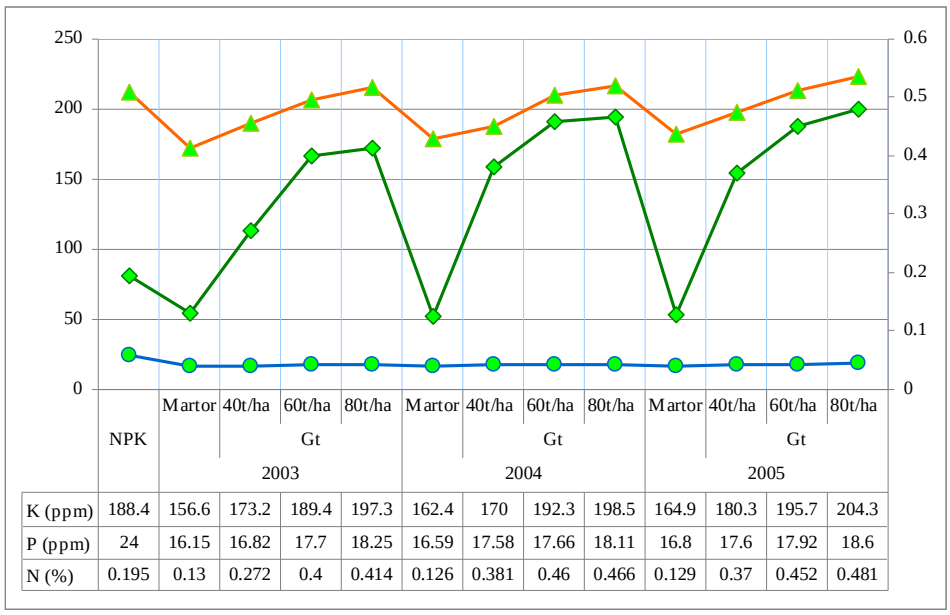
As reference point, we used a control variant on which we did not apply fertilisers at all. Average values of the main agro-chemical indices show a low acid pH 6.18 and a medium-good supply in nutrients. The nitrogen content (0.13%) denotes a medium fertility and supply with this nutrient. The phosphorus content (16.15-16.8 ppm) is within poor supply limits, and potassium content (156.6-164.9 ppm) is within good supply limits.

Mineral fertilisation results in a slight acidification of the soil, pH values going down to average values of 6.01, lower with 0.17 units compared to the control variant.



	NPK	Martor	40t/ha Gt	60t/ha Gt	80t/ha Gt	Martor	40t/ha Gt	60t/ha Gt	80t/ha Gt	Martor	40t/ha Gt	60t/ha Gt	80t/ha Gt
		2003				2004				2005			
Series 1	6.01	6.18	6.25	6.33	6.51	6.17	6.42	6.49	6.61	6.16	6.82	6.93	7.08

Figure1. Evolution of the pH under the influence of organic fertilisation (animal manure) of the cambic phaeosiom at Timişoara (2003-2005)



	NPK	Martor	40t/ha Gt	60t/ha Gt	80t/ha Gt	Martor	40t/ha Gt	60t/ha Gt	80t/ha Gt	Martor	40t/ha Gt	60t/ha Gt	80t/ha Gt
		2003				2004				2005			
K (ppm)	188.4	156.6	173.2	189.4	197.3	162.4	170	192.3	198.5	164.9	180.3	195.7	204.3
P (ppm)	24	16.15	16.82	17.7	18.25	16.59	17.58	17.66	18.11	16.8	17.6	17.92	18.6
N (%)	0.195	0.13	0.272	0.4	0.414	0.126	0.381	0.46	0.466	0.129	0.37	0.452	0.481

Figure 2. Content of nutrients under the influence of organic fertilisation (animal manure) of the cambic phaeosiom at Timişoara (2003-2005)

Nitrogen content in the soil reaches values of 0.195% N, which shows an increase with 0.065 units compared to the control variant (0.13% N) and a very good supply with this element.

Phosphorus regime at the level of the agro-ecosystem improves through mineral fertilisation, its content increasing up to 24 ppm compared to 16.15 ppm in the control variant. Potassium, already well supplied, also records an increase of 31.8 compared to the control variant, reaching 188.4 ppm.

Mineral fertilisation ensures a high level of supply with nutrients and, therefore, high and stable yields, being a means of supporting vegetal production for intensive agricultural systems.

Within alternative agricultural systems (ecological agriculture, biological agriculture, and biodynamics) the present legislation allows the use of organic fertilisers and of mineral fertilisers.

Within our research we used organic fertilisers, i.e. animal manure at rates of 40 t/ha, 60 t/ha, and 80 t/ha, respectively incorporated into the soil through the basic land work.

The organic fertilisers we used introduced into the soil annually important amounts of nutrients, but their availability for the plants is only possible with the changes of the organic matter (decomposition, mineralization) (Table 1).

Table 1

Amount of nutrients introduced into the soil
through fertilisation with animal manure (average values)

Fertilizer period	Nutrients introduced into the soil (kg/ha)								
	N (0.5%)			P_2O_5 (0.25%)			K_2O (0.6%)		
	40 t/ha	60 t/ha	80 t/ha	40 t/ha	60 t/ha	80 t/ha	40 t/ha	60 t/ha	80 t/ha
yearly	200	300	400	100	150	200	240	360	480

The use coefficients of nutrients differs within the categories and from one year to another. Reference values from the point of view of assimilability in time of nutrients from animal manure show for 20-25% use of nitrogen, 30-40% use of phosphorus, and 60-70% use of potassium in the first year.

Taking into account the rates of animal manure applied as fertilisers, the average content in nutrients, and assimilability coefficients in time, we can say that this organic fertiliser has a favourable, cumulative effect.

By applying animal manure, a series of chemical processes in the soil lead to an improvement of the reaction, so that in the third year of organic fertilisation there is an increase of the values of the pH of up to 0.9 units compared to the control variant and to the variant fertilised with mineral fertilisers.

As for the regime of the nutrients, if in the first year of application of animal manure the effect is lower, starting with the second year there is accumulation of the direct annual fertilisation and of the remnant one, so that available nutrients accessible are more (Figure 3).

In the case of the phosphorus, there is a moderate increase of the soil reserve through fertilisation with animal manure as a result of the lower content of phosphorus in the fertilisers.

Nitrogen and potassium regime is much more improved as animal manure is a nitrogen-potassium fertiliser. Thus, total nitrogen content increases with 0.13% in the control to 0.48% when fertilised with 80 t/ha of animal manure, the effect being more obvious in time.

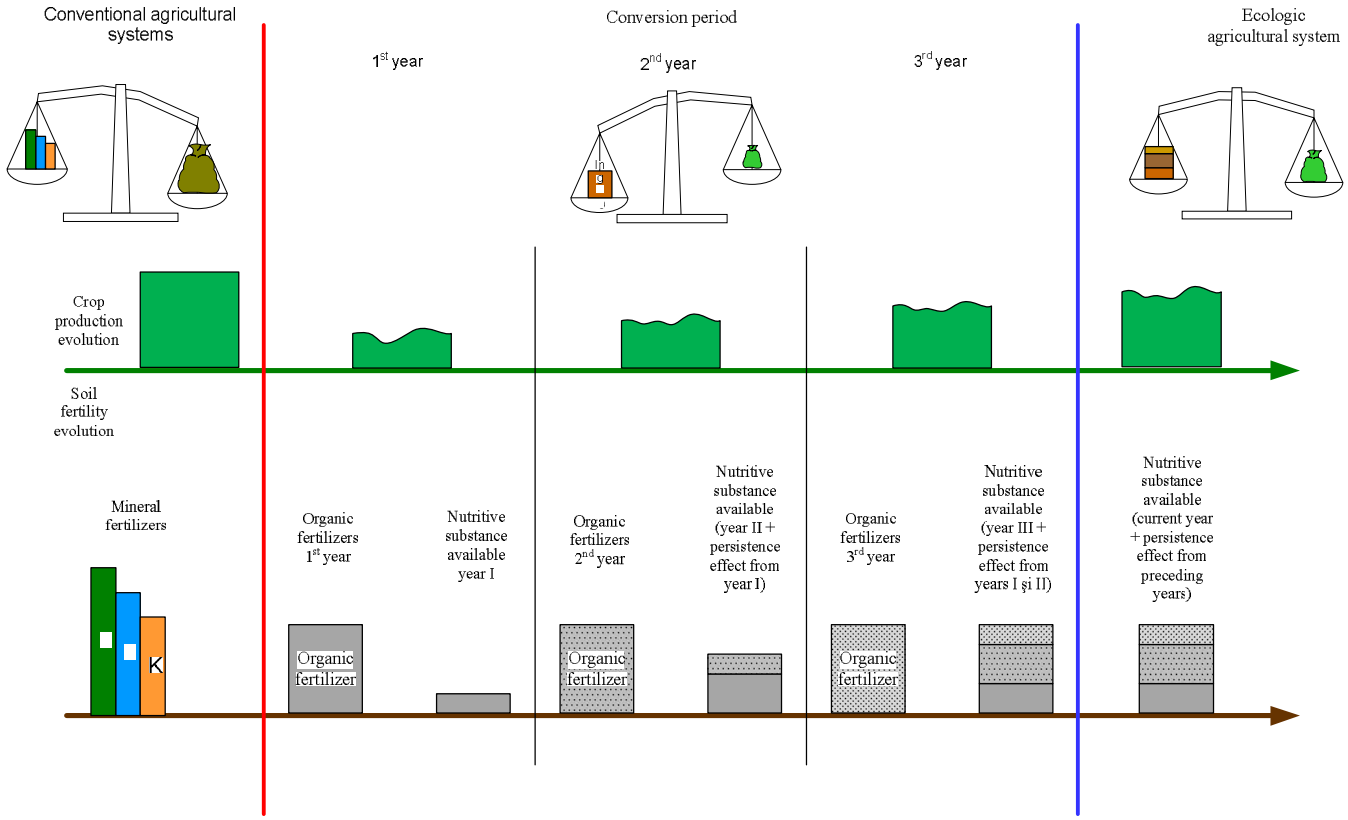


Figure 3. Conversion and dynamic balancing period of soil fertility

Soil supply in potassium through animal manure fertilisation was more consistent, so that potassium content increases from 156.6 ppm in the control, to 170-204.3 ppm through successive accumulations, more obvious in the second and third years of application and when fertilised with 80 t/ha of animal manure.

CONCLUSIONS

In the context of conversion from conventional agriculture, based mainly on mineral fertilisation and with high rates of fertilisers, to ecological agriculture, rebalancing soil fertility during the conversion period is one of the major objectives in ensuring favourable nutrition balances of the crops in the new production system.

Results through animal manure fertilisation show it is possible to remake the nutrients balance in the soil in order to prepare the agricultural land for an alternative agricultural system – the ecological one. Improving soil reaction, successive accumulations of nutrients in the soil lead to a new balance of fertility with a new dynamics based on organic fertilisers, much more complex and stable in time.

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