CLAY MINERALS IMPACT UPON SOME MICROORGANISM POPULATION OF SOIL

IMPACTUL MINERALELOR ARGILOASE ASUPRA UNOR POPULAȚII DE MICROORGANISME DIN SOL

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Abstract: *The paper is an attempt of quantification of clay minerals influence upon the population of certain groups of micro organisms from soil. The aim of this paper is to verify and to validate the earlier established relationships between soil biological and mineralogical parameters in a context of qualitatively and quantitatively extended pedological information. The obtained results confirm to a great extent the former ones. Thus, the established relationships between biological and mineralogical parameters indicate that the bacteria and fungus number are closer related to the clay quality than to its quantity. The same relationships show that between the soil biological indicators and clay iolite content there is a direct linear relation, while between the same biological parameters and the clay smectite content this linear relation is inversed. The confirmation of these relationships on statistical basis, using results of physical and chemical determinations, becomes more difficult when the number and complexity of the considered situations are increased.*

Rezumat: *Lucrarea prezentă reprezintă o încercare de cuantificare a influenței mineralelor argiloase asupra unor anumite populații de microorganisme din sol. Scopul lucrării este de a valida şi verifica relațiile stabilite între indicatorii microbiologici şi cei mineralogici, obținute anterior, în contextul utilizării unei informații furnizate de un număr mai mare de probe aparținând la diferite tipuri de sol din diferite zone ale țării. Rezultatele obținute confirmă la o scară mai largă pe cele obținute anterior. Astfel, relațiile stabilite între parametrii biologici şi mineralogici indică faptul că numărul de bacterii şi de ciuperci este mult mai strâns legat de calitatea argilei decât de cantitatea acesteia. Aceleaşi relații ne arată că între indicatorii biologici ai solului şi conținutul de illit din argilă există o corelație liniară directă, în timp ce între aceeaşi indicatori biologici şi conținutul de smectit din argilă relația liniară este inversă. Confirmarea acestor relații pe cale statistică, utilizând rezultatele furnizate de unele determinări fizice şi chimice, devine mai dificilă pe măsură ce numărul şi complexitatea situaților luate în considerare creşte.*

Key words**:** *clay minerals, clay minerals – micro organism relationships*
Cuvinte cheie: *minerale argiloase, relații între mineralele argiloase şi microorganisme*

INTRODUCTION

Due to multiple evidence of inorganic components influence over soil micro organism (HUANG, 1990; THENG AND ORCHARD, 1995), in present, the soil mineralogical composition is considered a main part of micro organism ecology. One of the main agents regarding the influence over physical and chemical properties is the mineralogical composition of clay fraction. The clay minerals impact over micro organisms can be direct (direct interaction through adhesion between mineral particle and micro organism) or indirect (habitat modification with favourable or inhibitory effects over growth and metabolism of micro organism or an entity).

Minerals interaction (especially mineral colloids) with micro organisms has substantial consequences over their ability to alter minerals from soil, to protect the organic matter, to transform the nutrients and pollutants.

In general, the results of researches regarding clay minerals influence over some micro organism groups (NOVAKOVA, 1968, 1969; FILIP, 1969, 1973; STOTZKI, 1972; KUNC AND STOTZKI, 1974) and over their enzymes (KISS, 1958; GALSTYAN ET AL., 1968; RAO ET AL., 1998; QUIQUAMPOIX ET AL., 1998; HUANG ET AL., 1998) are restricted by laboratory conditions.

Previous researches performed by CRĂCIUN AND DUMITRU (2000) using direct data from edaphic environment of some chernozems from Romanian Plane had lead to some relations between certain micro organism populations (microscopic fungus number and bacterium number) and the clay mineralogical composition. The established relationships between biological and mineralogical parameters have been confirmed by the established relationships between the same parameters (biological and mineralogical) and others which express some physical and chemical properties of the investigated soils.

The paper purpose is to verify and validate the earlier established relationships between microbiological and mineralogical indicators previously obtained in a context of qualitatively and quantitatively extended pedological information.

MATERIALS AND METHOD

A number of 105 samples from 25 soil profile were analysed from mineralogical and biological point of view. The soil profiles belonging to different soil types (kastanozems, chernozems, phaeozems – chromic luvisols, haplic luvisols, albic luvisols, planosols, and eutric cambisols gleysols haplic solonchaks).

Some of the analytical results can be found in the guides of RNSSS Conference from Piteşti, Tulcea, Bucureşti, and Suceava.

For statistics relations had been selected a series of microbiological parameters and indicators (bacterium and fungus microscopic number), mineralogical (smectite, iolite and kaolinite content), physical (clay content, air porosity) and chemical (exchangeable potassium) parameters. Relations between these parameters had been tested using linear, polynomial, exponential, power and logarithmic equations.

RESULTS AND DISCUSSION

The treatment of luvosoil with four different doses of industrial waste showed important changes regarding soil fertility.

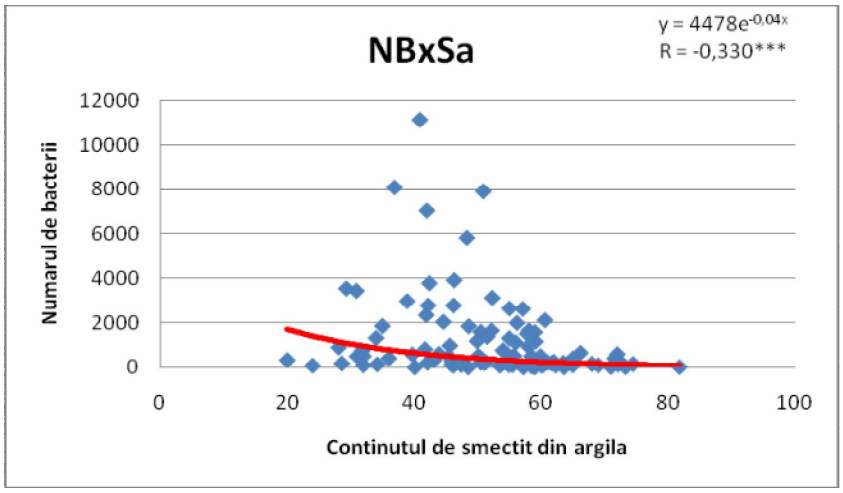
Regarding the established relationships between biological and mineralogical parameters it must be mentioned that the results are similar indifferent to correlation way. In spite of some small differences regarding the correlation coefficients value, the signification is mostly the same.

Also we must specify that because of insignificant results obtained on kaolinite (because of small content of this mineral); the results will refer only to the main clay components, smectite and iolite.

Like in the molic soils from the Romanian Plane, the relations between microbiological indicators of investigated soils and the clay content are insignificantly, the obtained results confirm the previous published data (CRĂCIUN AND DUMITRU, 2000). But we obtained significant results on relations between microbiological parameters and main clay components, iolite and smectite, these results confirming also the previous published data.

In figures 1 and 2 are represented comparatively the relationships between main clay components, smectite and iolite and the bacterium number, with the microscopic fungus number respectively. These relationships differ from a mineral to another, but are the same for both microbiological components of soil. Therefore, the relation between the iolite clay content and the bacterium number, the microscopical fungus number respectively (both of them having

a very significant correlation coefficient) is direct, while the relations between the smectite content and the same microbiological parameters is reverse, with a higher correlation coefficient for bacteria number.



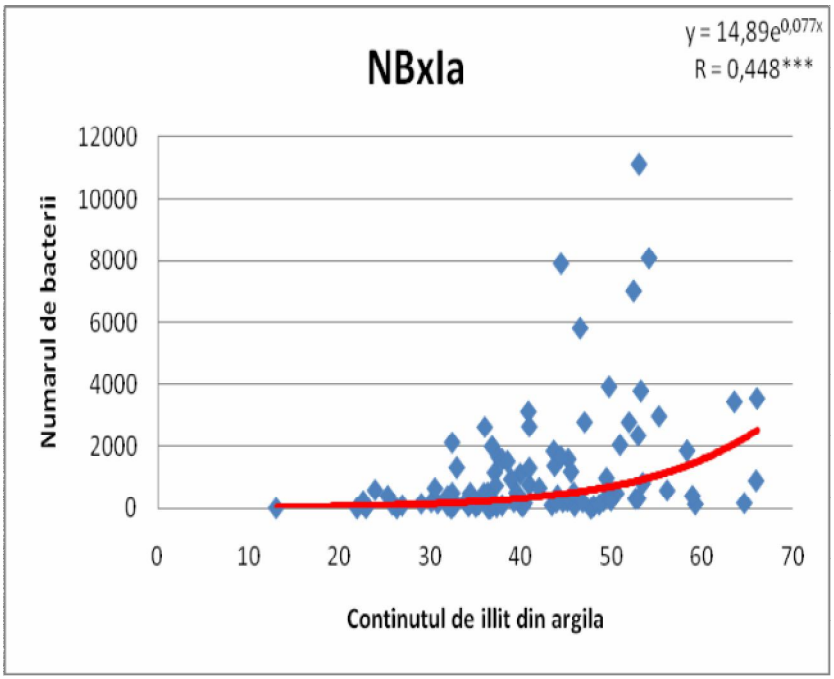


Figure1. Relations between clay minerals (fraction under 2μ) and bacteria number

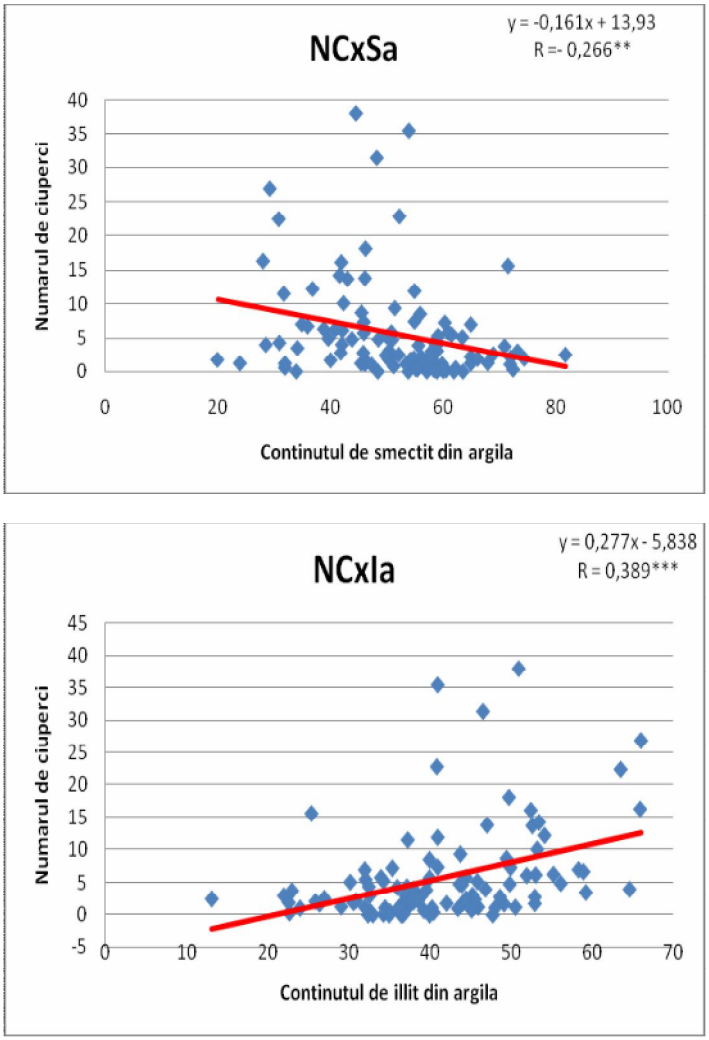


Figure 2. Relations between clay minerals (fraction under 2µ) and fungus number

As we can observe in figures 1 and 2 there is a difference between correlation coefficient values, the highest value is obtained with exponential relation for bacteria number and with linear relation for fungus number.

The obtained results which confirm the previous published data (CRĂCIUN AND DUMITRU, 2000) regarding relations between clay minerals and microbiological indicators, lead to these 3 important aspects:

First one refers to the fact that results obtained in the case of only soil type located in the certain zone are quite similar with these obtained in a context of a complexity and diversity of conditions due to an extension of investigated area from the edaphic and geographic point of view. In other words, the established relationships appear to be valid not only for a local situation but also for a widespread context.

Significant results regarding the relationships between mineralogical and biological parameters are obtained when we use the clay minerals content instead of clay quantity. In other words, the bacteria and fungus populations seems to be closely related to clay quality but not to clay quantity from soil.

The third aspect refers to the opposite relationships of the microbiological parameters with the two clay components, which point out the stimulating role of iolite and inhibitive role of smectite for the certain micro organism population of soil. These results are surprising at least for smectite because in previous researches the influence of clay minerals over some *Rhizobium bacterium* in dry and semi dry climate, couldn't be differentiate between smectite and iolite (MARSHALL, 1968). Previous researches concerning to some relations between Chemical (exchangeable potassium) or physical (air porosity) properties with biological and mineralogical indicators, had validate, for chernozems from Romanian Plane, the relations between biological and mineralogical indicators, suggesting that the clay minerals impact over micro organism populations are caused by indirect influence over microbial habitat (CRĂCIUN AND DUMITRU, 2000).

The attempts in order to obtain the similar confirmation in a wider edaphic diversity and complexity have led to insignificant results, suggesting that such of confirmation are difficult to obtain on the statically way.

CONCLUSIONS

The results of correlation attempts of some microbiological indicators with mineralogical parameters of the clay fraction, from different soil types evolved in different areas of Romania are significant only for main clay mineral components, smectite and iolite, pointing out that the some soil micro organism populations (bacteria and fungus) are closely related to the clay quality and not to the clay quantity.

The results established relationships, between some biological indicators (bacteria and fungus number) and the main clay components are direct for iolite and inverse for smectite. The results are not changing, no matter how many cases we take in consideration. The validation of this relations on statistically way when using results from physical and chemical determinations is become more difficult when the number and complexity of situations taken into consideration, increase.

The obtained results suggest that the influence of clay minerals over some micro organism populations is indirect, by the impact of these minerals over some physical and chemical properties of the microbial habitat. Proofs in order to sustain this idea can be obtained statistically in cases when the variation of the edaphic conditions is limited.

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