Impacts of organic and inorganic amendments on physical and chemical properties of sandy soils from Nyírség geographical area

Thesis of PhD dissertation

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INTRODUCTION

Importance and current status of the topic

About 53.5% of the total area of Hungary is influenced by soil degradation processes such as high sand content, acidic pH, and salizination in the upper and deeper soil horizons, high clay content, water logging, erosion and continuous hard rock close to the surface (Várallyay, 1984).

One quarter of the total area of Hungary is covered by light textured soils, of which 16% is sandy, 9.5% is sandy loam. These soils occur in most of the genetic soil types (Várallyay, 1984).

Sandy soils are lacking organic and inorganic colloids. These are the reasons, why the fertility and the properties of these soils are determined by high water infiltration and weak water storage capacity, low available water and natural nutrient capacity, sensitivity for aridity and wind erosion (Várallyay, 1984).

Various and important experiments were carried out to improve sandy soils in Hungary from the 20th century on crop rotation – green manuring, stable manuring, fertilizing, liming, permanent - Egerszegi sand improvement, using of local organic and inorganic compounds, lignite – liquid manure application (Kreybig, 1944; Westsik, 1951; Egerszegi, 1953, 1958; Márton, 1969; Prettenhoffer, 1981; Kazó et al, 1981, 1983; Kazó, 1981; Stefanovits and Fekete, 1984; Dömsödi, 1984; Kádár and Vass, 1988; Köhler, 1989; Szemes and Kádár, 1990; Bauer and Cserni, 1993; Lazányi, 1994; Antal, 1998).

Objectives

From the fifties and seventies, lots of experiments were carried out on application of organic and inorganic colloids in sand soils. As the time passed, newer techniques and methods appeared in soil and related sciences. Applications of these novel tools have not yet been introduced in soil science practices.

The purpose of the study was to answer the following questions:

1. Does the application of mineral colloids together with precomposted organic materials result in favorable changes on structural and colloidical properties of sandy soils?
2. Does the addition of $CaCO_3$ to the complexes result in further favorable effects?
3. Is rheology a suitable method to detect the changes in different chemical and physical properties of soils?
4. Can the results of simplified methods be compared with the results of rheological measurements?
5. Do the filed experiments provide similar results as the laboratory investigations?

Lab samples and field samples were investigated to answer the questions which were raised in the objectives.

MATERIALS AND METHODS

Materials

My research was carried out on different composition of lab and also on filed samples. The filed samples originated from Debreceni Agrárcentrum Teichmann Farm (Kisvárda), where composted sewage sludge was applied.

Laboratory model samples

Different compositions of organic and inorganic compounds were prepared for the lab investigations.

The investigated sand samples originated from Debreceni Agrárcentrum Nyíregyházi Westsik Vilmos Experimental Station. Composite samples were taken from the upper 15 cm soil layers. The soil was classified as „humic sand, not calcaric, overlaid".

Refuse bentonite from Mád, montmorilonite from fractionated bentonite from Kuzmice (Czech Republic) and beet potash from Szerencs Sugar Company were used as inorganic compounds.

Liquid manure of dairy from Szent István Egyetem Józsefmajor Experimental Farm was applied as organic component.

The sand samples were dried, grinned and sieved on 2 mm size, and I used the fallen parts were used in my experiments. Complexes were prepared with increasing amount – 2%, 5%, 10% of montmorillonite and bentonite and than the added 30 ml of tap water to the 100 g weight samples, covered by gauze and let them dry.

Different amounts of bentonite 0g, 20g, 50g, 100g were mixed to 1 liter liquid manure, stirring occasionally until the pH equilibrium. 1kg sand was added to the samples and let them dry, covered by gauze. Doubled amount of $CaCO_3$ was also added to the samples calculated from the y_1 value of the sand samples; it meant 0.5g beet potash to 1kg sample.

Abbreviations of the samples are given in Table 1.

Table 1: Abbreviations of used materials and model samples

Name of the sample	Abbreviation
Sand	S
Bentonite	b
Montmorillonite	m
Beet potash	Ca
Liquid manure	ht
Sand – 2, 5, 10 % bentonite	S – 2, 5, 10 % b
Sand – 2, 5, 10 % montmorillonite	S – 2, 5, 10 % m
Sand – beet potash	S – $CaCO_3$
Sand – 2, 5, 10 % bentonite – liquid manure	S – 2, 5, 10 % b - ht
Sand – 2, 5, 10 % bentonite – liquid manure – beet potash	S – 2, 5, 10 % b - ht - $CaCO_3$

Field samples

The field samples were originated from 0.5 hectare small parcels experiments. The soil type was lammelic brown forest soil.

„Nyírkomposzt" compost was applied on the field. After dehydration of the fermented sewage sludge it was composted with different inorganic compounds. The compost contained: 40% sludge, 25% riloite, 15% benonite, 10% lime and 10% straw.

20 t/ha compost was cultivated in September 2003. The first sampling campaign was carried out in June 2004 and to prove the effect of compost the procedure in September 2006 was repeated. Composite samples were collected from 10 samples from the control and the treated field as well from the layer 0- 20 cm. White lupine was produced in the years of sampling.

Methods

The applied soil chemical methods in the thesis

- Cation exchange of the samples by modified Mehlich procedure (Buzás, 1988)
- Organic matter content of the field samples by Walkley – Black method (Nelson and Sommers, 1996).

The applied soil physical method in the thesis

- Hygroscopity of the samples by Sík (hy_1)
- Simplified water retention capacity of the samples
- Simplified determination of 0,02 mm particles in water and Na-pyrophosphate
- Microaggregate stability (Dispersity factor according to Kacsinszkij and structure factor by Vageler) (Buzás, 1993)
- Rheological properties of the samples

Statistical analysis

The statistical investigations were carried out using SPSS 15.0 for Windows.

Analysis of variance (One – way ANOVA LSD) was performed within the results at α level of 0.05. I illustrated my results on Box-Plot figures and indicated the statistical differences with the ABC letters.

Comparing the different results Pearson linear correlation was used. Correlation values (r) were defined which determine the tightness of the connections between the applied increasing amounts of treatments and the different soil parameters and the correlations between the results of applied methods. If the r is below 0.25, there is no connection between the two parameters, between 0.25 and 0.5 week medium correlation, and above 0.75 there is a strong relationship between the investigated parameters (Szűcs, 2004).

RESULTS

The most important findings of my doctoral research will be presented in the followings.

The results of organic matter content

An increase was detected after applying compost. Higher organic matter content was measured in samples from the treated site than in the samples from the control site in both of the sampling time. The organic matter content decreased between the two sampling period.

The results of cation exchange capacity

Improvements were observed after adding organic and inorganic compounds to the samples in cation exchange capacities and charge. There was a strong linear regression between the amount of applied components and the cation exchange capacity. In case of the lab samples the Pearson linear correlation value was 0.937 between the increasing amount of bentonite and CEC values, the Pearson linear correlation value was 0.906 after applying liquid manure and bentonite, and in case of the increasing amount of montmorillonite this value was 0.936.

In case of 5% and 10% bentonite containing samples there were no further increases in the CEC values. The organic and inorganic compounds react, neutralizing the charges.

An increase was detected in the CEC values due to the effect of the organic and inorganic compounds, but this increase was not significant in case of the filed samples. The charge was decreasing between the two sampling time.

The results of hygroscopity

In case of bentonite treatments the highest hy_1 value was measured at the highest bentonite application. There was no significant effect of the applied bentonite treatments on the hygroscopity results of the investigated samples. One reason could be of this result that the samples stayed for not efficient time in the vacuum dessicator and could not adsorb as many water as could. The other reason could be that the homogenizations of the samples were not perfect. The Pearson correlation value was 0.843, in case of pure bentonite application, which was weaker that was measured in case of CEC values.

The different liquid manure and benonite treatments had significant effects comparing to each others and to the other treatments. The correlation was strong between the increasing amount of bentonite and the hy_1 results, 0.995.

The highest hy_1 results were measured in case of the highest montmorilonite application. The correlation was strong between the increasing montmorilonite amount and the hy_1 results, (r = 0.996).

There was no effect on hy_1 results between the treatments and the passed time.

The results of water retention capacity

Based on the water retention measurements I have concluded (Figure 1) that the samples' water retention capacity increases with their mineral colloid content. This impact was more effective when beet potash or liquid manure was applied also. The most favorable effect was achieved with the joint application of liquid manure, bentonite and beet potash.

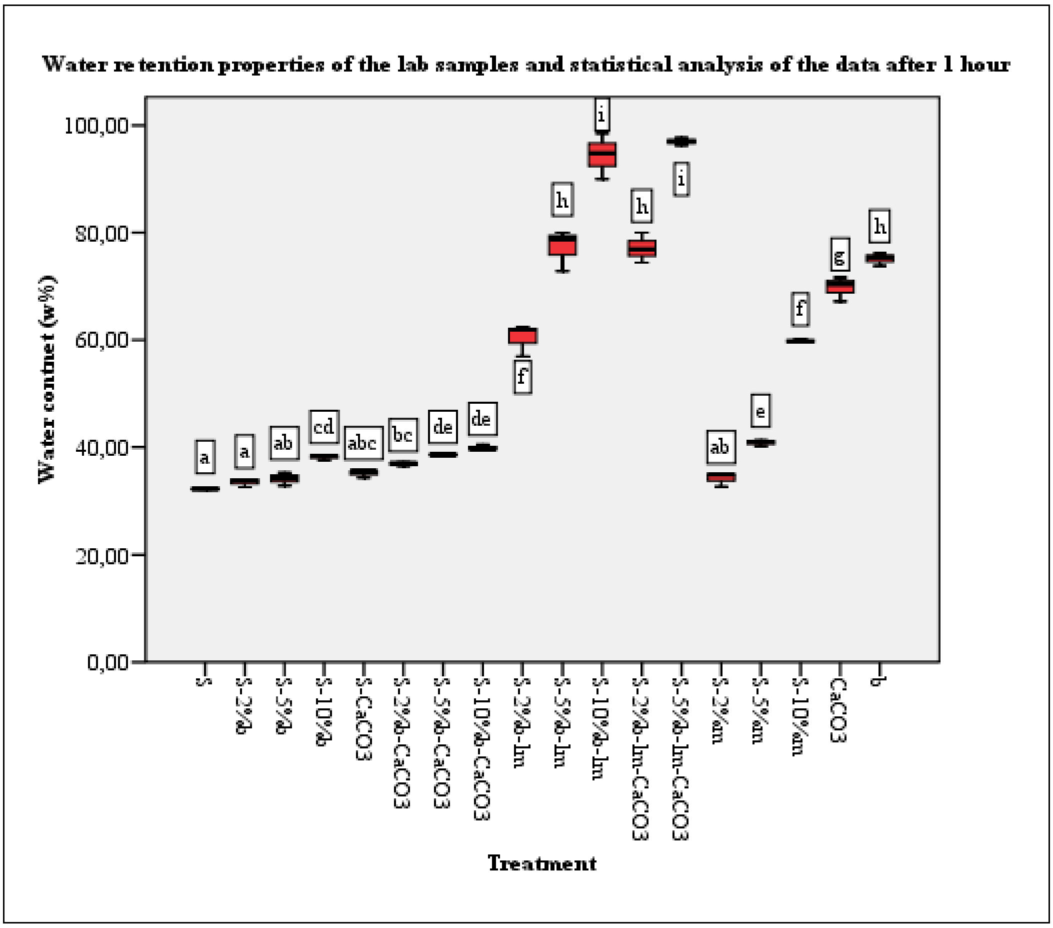

Figure 1: Moisture content of laboratory samples one hour after the start of the measurement, significant differences are indicated with the small letters of the ABC, with a confidence interval of 95%

Under field conditions, the water retention capacity of the samples increased due to the applied compost. At both sampling dates, samples from the treated areas retained more moisture than the ones from the untreated areas. The samples from the second sampling (2006) retained less moisture than the samples from the first date.

Results of simplified measurements of soil physical properties

During the determination of dispersed particles in water of the model laboratory samples, the smallest dispersed particles were measured in the sample containing sand – beet potash. This sample was significally different from the others. With the addition of bentonite, the dispersed particles content in water have significantly increased. The same results were obtained from samples containing only bentonite or liquid manure and different rates of bentonite and montmorillonite

There was a strong linear relation between bentonite content and dispersed particles content, with a Pearson's correlation coefficient of 0.936, while for samples containing both liquid manure and beet potash the same coefficient was 0.658. For the samples containing both liquid manure and bentonite a close relation was demonstrated between the increasing bentonite content and the results of dispersed particles in water, Pearson's correlation coefficient was 0.794. Stronger relation (0.813) was measured when both organic and two inorganic additives were applied. The closest relationship was shown in case of the increasing montmorillonite content, where r was equal to 0.984.

Similar results were obtained with the dispersion in Na – pyrophosphate.

Based on the calculation of the modified Kacsinszkij dispersion factor and the Vageler structure factor, the samples containing beet potash had the weakest microstructure. The strength of the microstructure was increasing with the rate of applied organic and inorganic additives.

In case of the field samples, those treated with compost showed the highest dispersed particle content. Two years after the treatment less dispersed particles were measured within the upper layer.

In case of the Kacsinszkij dispersion factor and the Vageler structure factor the compost treatment showed no statistically significant effect.

Results of the rheological measurements

During the rheological measurements I have determined the initial maximum of the flow curves, τ_{inimax} (Pa), which is the maximum of the flow curves determined in the direction of the increasing velocity, and provides information on the structure of the soil, and the bonding forces at present. The Bingham yield value (τ_B) was also determined which is the value of the linear part of the curves projected to zero shearing stress, and provides information on potential aggregation in the decreasing velocity gradient range following the discontinuation of the shear stress.

Results of the maximum yield values (τ_{inimax})

On increasing the bentonite content of the sand samples, the initial maximum of their flow curves increased. There was a strong linear correlation between the two parameters, with a Pearson's coefficient of 0.923.

The relation was even stronger in case of samples containing beet potash and increasing amounts of bentonite. In this case Pearson's coefficient was 0.936.

At the same time, due to the sensitivity of organic matter, Pearson's correlation coefficient was 0.847 when the samples contain two inorganic components besides the liquid manure (Figure 2). The explanation in this case could be that bentonite – organic matter – Ca agglomerates were formed instead of link together the sand particles. The reason for the fact that the highest initial maximum values were not obtained from the samples containing both organic and inorganic additives could be that their organic component, due to its complicated structure, was very sensitive to external effects, such as shearing stress.

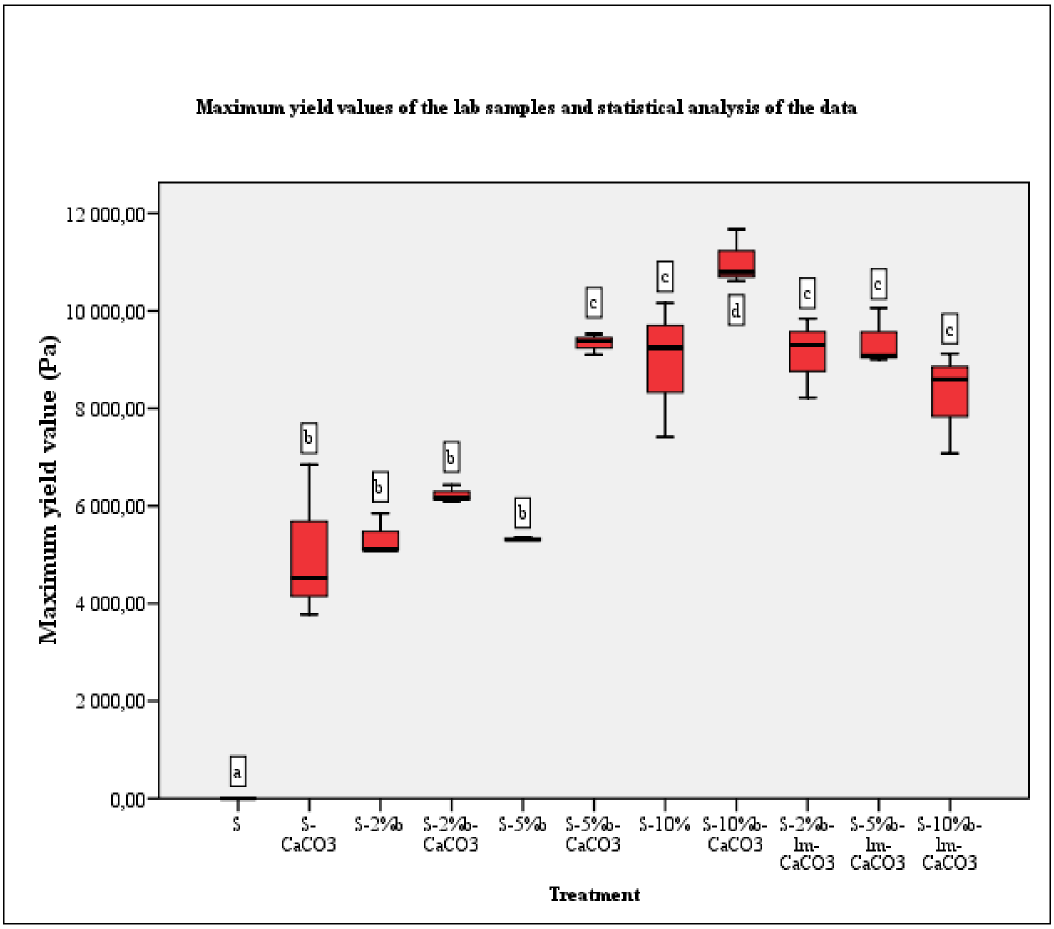

Figure 2: Maximum yield values of the flow curves of laboratory samples, significant differences are indicated with the small letters of the ABC, with a confidence interval of 95%

In case of field samples, the one from 2004, treated with compost could tolerate the highest shear stress. As an effect of the compost treatment, the strength of the bonds between the particles became stronger, due to the organic and inorganic additives within the compost. The treated samples from 2006 have already produced significantly similar results to those of the untreated samples. As a result of the treatment the suspension showed aggregation, that wasn't present at the second sampling. This was probably due to the repeated yearly disturbance, or the downward movement of organo-mineral complexes.

Results of the Bingham – yield values (τ_B)

The rebuilding of the suspension aggregates was only observed in the case of samples with organic matter content, and not with samples containing only mineral materials (Figure 3).

The reason for this was that after the ceasing of external action the organic material, due to its great charges, could relatively quickly form organic matter – bentonite – Ca bridges, and that because of the presence of organic matter, microbial activity should also was considered. The fulvic acids formed during the microbial decomposition of unrecompensed dead organic residues and the Ca^{2+} ions in the system connected with the negative charges of the clay minerals.

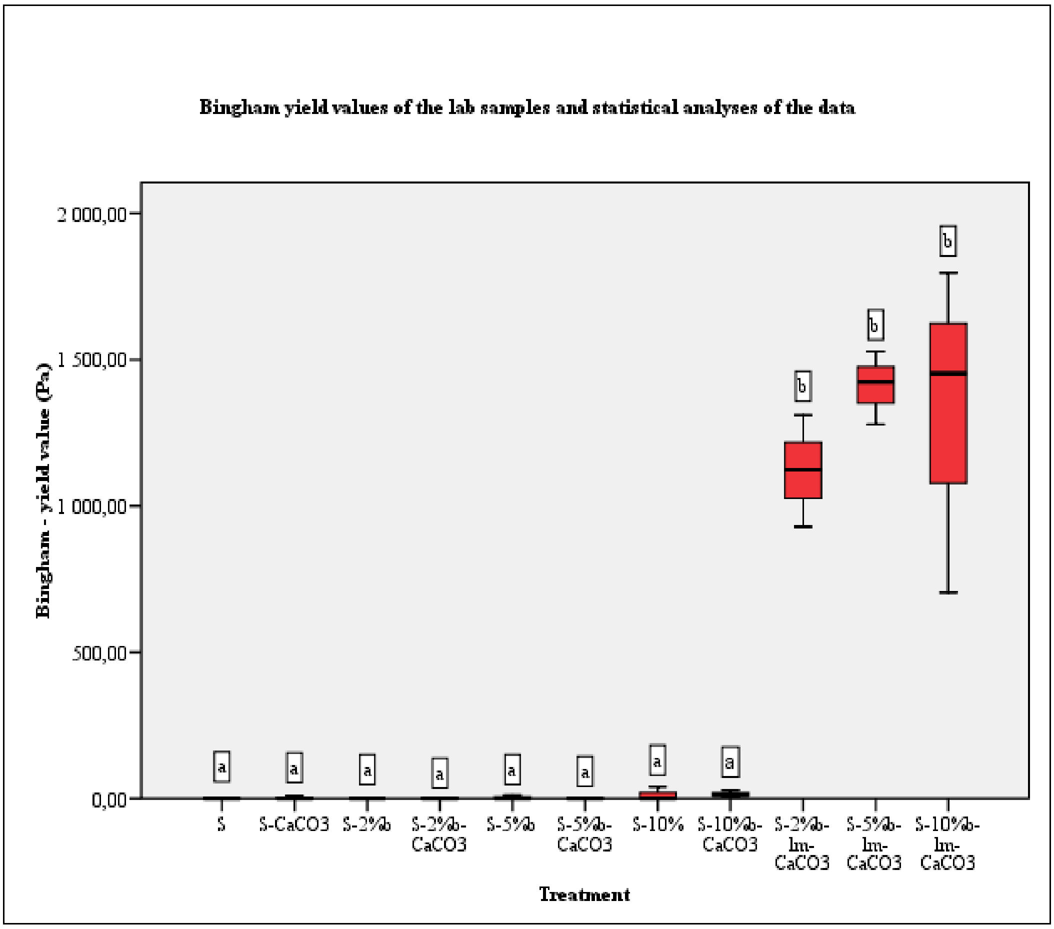

Figure 3: Bingham –yield values of the flow curves of laboratory samples, significant differences are indicated with the small letters of the ABC, with a confidence interval of 95%

In case of field samples, the one from 2004, treated with compost had the highest Bingham – yield value, which means that as a result of the compost treatment, due to the organic and inorganic additives applied to the soil, the structure of the soil suspension showed re-aggregation after disturbance, on account of the increased number of bonding points. This effect could not be observed in the second sampling season, which could be because the organ mineral complexes have either ceased to exist or moved to the lower layers.

Statistical comparison of the applied simplified methods

Table 2 shows the statistical comparison of the simplified methods, indicated by the Pearson’s linear correlation coefficient.

The results of the water retention capacity method showed medium correlation with the results both in dispersed particles in water and Na - pyrophosphate. The reason for this is that due to the different treatments less dispersed particles were mobilized.

The results of two dispersing methods gave strong correlation with each other. At the same time, the dispersed particle content in water results showed medium correlation with the calculated Kacsinszkij dispersion factor and the Vageler structure factor.

The results of the Kacsinszkij- and Vageler factors also showed a strong, but negative correlation.

Table 2: The correlation results of the used simplified methods,
****: correlation is significant at 0.01 levels**

	Water retention capacity	Dispersed particles in water	Dispersed particles in Na-pyrophosphate	Kacsinszkij dispersion factor	Vageler structure factor
Water retention capacity	1	0.435**	0.414**	-0.334*	0.308*
Dispersed particles in water	0.435**	1	0.884**	-0.466**	0.477**
Dispersed particles in Na-pyrophosphate	0.414**	0.884**	1	-0.765**	0.814**
Kacsinszkij dispersion factor	-0.334*	-0.466**	-0.765**	1	-0.965**
Vageler structure factor	0.308*	0.477**	0.814**	-0.965**	1

Statistical comparison of the simplified methods with the traditional methods

Table 3 shows the statistical comparison of the simplified and traditional methods, indicated by the Pearson's linear correlation coefficient.

Table 3: The statistical comparison of the simplified and traditional methods,
****: correlation is significant at 0.01 levels**

	Water retention	Dispersed particles in water	Dispersed particles in Na-pyrophosphate	Kacsinszkij dispersion factor	Vageler structure factor
hy_1	0.540**	0.469**	0.601**	-0.692**	0.696**
CEC	0.461**	0.946**	0.946**	-0.684**	0.664**

There was a strong medium relationship between the water-retention and hy_1 measurements, while a weak connection with the results for cation-exchange capacity. In my opinion, the water retention capacity results should have given stronger correlation with the hy_1 results, but in the case of samples containing only bentonite these results were measured, probably due to the inproper execution of measurements – the samples were not keep long enough in the excitatory or the components of the mixture were not appropriate.

The closeness of the relation between hy_1 and cation-exchange capacity is medium ($r = 0.516^{**}$).

A poor correlation was found between the results of the hygroscopity measurements and the dispersed particles content in water and Na - pyrophosphates. At the same time, the cation-excange capacity results showed strong correlation with the dispersed particle content measured by two different methods.

The results of the calculated factors showed a strong correlation with the results of both the hygroscopity and cation-exchange capacity. Naturally in this case there is a strong negative correlation with the calculation of the dispersity factor.

Correlation analysis of the results from rheology and other applied measurements

Table 4 shows the correlation comparison of the results from rheology and the applied measurements indicated by the Pearson's correlation coefficient.

Based on the results it can be concluded that a linear relationship could be observed between the initial maximum of the flow curves (τ inimax), the results of hy_1 and cation-exchange capacity. That was, on the application of organic and inorganic additives, if we increase the colloid content (and charge) of the soil, it also increases the maximum shear stress it could tolerate.

The Bingham – yield values showed strong correlation with the results of the water retention measurements. This means that if the soil's water-bonding capacity increases, so does its ability to re-aggregate suspension after the end of the stress it was exposed to. The Bingham – yield values showed a strong medium connection with dispersed particles content in water, and a weak medium connection can be observed with the dispersed particles content in Na - pyrophosphate.

Table 4: The statistical comparison of the results of rheological measurements and results of traditional methods, *: correlation is significant at 0.05 levels, **: correlation is significant at 0.01 levels n. c.: no correlation,

	Water retention	Dispersed particles in water	Dispersed particles in Na-pyrophosphate	Vageler structure factor	Kacsinszkij dispersion factor	hy_1	CEC
τ inimax	0.444*	0.391*	n. c.	n. c.	n. c.	0.788**	0.820**
Bingham yield value	0.985**	0.666**	0.497**	n. c.	n. c.	n. c.	n. c.

CONCLUSIONS, RECOMANDATIONS

New scientific results

Previous researches in Hungary, targeting the improvement of sandy textured soils have mainly focused on changes affecting the fertility and chemical properties of soils. The number of articles and studies reporting on the changes to the physical properties of soils is much lower. During the improvement of sandy soils, beyond changes in chemical parameters, also the physical properties of the soil can improve, subject to the constitution and quantity of applied materials. My research has proven both on laboratory model samples from sandy soils of the Nyírség area and on field experiments that there are physical and chemical changes in soils as an effect of different additives. My measurements have concluded that rheology is a suitable method for the examination of different soil physical and chemical properties.

Based on the research, my new scientific results are summarized in the following:

1. Clay minerals, rocks containing clay minerals and also materials containing $CaCO_3$ have a significant effect on soil properties. Due to their colloid and adhesive properties, they increase the strength of bonds between soil particles
2. Both physical and chemical measurments properties showed better improvement when the organic and inorganic components were precomposted before application.
3. The addition of beet potash resulted further favorable effects on the results of water retention capacity and rheological measurements.
4. Rheology proved to be a suitable method to track changes in soils resulting from the addition of different mineral and organo-mineral materials. It provides quantitative measures of the forces linking together the soil particles (maximum yield value, Bingham – yield value).
5. The results of rheological measurements can be compared and do show a certain level of similarity with other methods measuring different soil chemical and physical parameters.
6. I have verified that in soils it is primarily the „newly added" organic material content that takes part in the re-aggregation of the suspension structure after disturbance, as opposed to the mineral components.
7. My research proved that results of the applied „simplified" methods show a certain level of similarity both with each other and with the results from the traditional methods, thus they are suitable for monitoring the changes in the soil physical and chemical properties.
8. The additional results the study was, that betonite added to the liquid manure has significantly reduced its odor.
9. The field trials proved that applied in the same quantities and type of soils, as in the experiment, the materials resulting from the composting of wastes containing high amount of organic materials, can be suitable to improve the chemical and physical properties of the soil for up to two years.

Recommendations for further research

Unfortunately, there were several other soil physical parameters that I could not address in my research. I did not have the chance to investigate the effect the materials (complexes) I have compiled would have on the plant-environment system on the field or pot trials.

According to the Central Statistical Office, due to the decrease of animal stocks, the 8-9 million tones per year use of manure has been reduced to its half, 3.9 million tones within ten years. The amount of sewage sludge is increasing year by year because of the public services. The use and annihilation of this product or if it is possible the allocation cost a lot. In spite of these tendencies, the nutrient supply of our soils must be maintained, taking into account the increasing production of energy plants that could withdraw a significant amount of organic matter from our soils. Thus it is practical to search for those materials that are designated as waste in their point of production, but their constitution provides that they can be used immediately or after some pretreatment, such as composting, for field / horticultural / forestry purposes. It is to be examined that in their intended place of use, what effect they have on our environment, the chemical, physical and biological state of our soils, our groundwaters and the produced crops.

The use of rheological measurements in soil physics contains several possibilities besides the parameters included in my research. It is suggested to use it for other samples, on series extended to detect the chemical, physical and biological degradation of soils, and on samples from additional field trials. As a method it is worth comparing to other soil physical and chemical methods, using additional field samples.

LIST OF REFERENCES

Antal J. (1998): Talajművelés és zöldtrágyázás. In Homoktalajok hasznosításának időszerű kérdései a hazai homokkutatások tükrében. Konferencia kiadvány. Kecskemét. p.: 15.-18.

Bauer F. and Cserni I. (1993): A Duna-Tisza közi homokhátság mezőgazdasági hasznosításának kérdései. A Nyírség mezőgazdasági fejlesztésének lehetőségei és távlatai c. Tudományos Ülés. Nyíregyháza. p.: 25-28

Buzás I. ed. (1988): Talaj- és agrokémiai vizsgálati módszerkönyve 2. A talajok fizikai-kémiai és kémiai vizsgálati módszerei. Mezőgazdasági Kiadó, Budapest. p.:90-92

Buzás I. ed. (1993): Talaj- és agrokémiai vizsgálati módszerkönyve 1. A talaj fizikai, vízgazdálkodási és ásványtani vizsgálata. INDA 4231 Kiadó, Budapest. p.:42, 50-54, 76,

Dömsödi J. (1984): Homoktalajok termőképességének fokozása talajjavító (szerves és ásványi) anyagokkal. Agrokémia és Talajtan Tom. 33. 1-2 p.: 175-182.

Egerszegi S. (1953): Homokterületeink termőképességének megjavítása „altalajtrágyázással". Agrokémia és Talajtan 2. p.: 97-107.

Egerszegi S. (1958): A réteges homokjavítás. Agrártudomány 10. 2-3. p.:1-7

Gáti F. and Kazó B. (1965): Kísérletek agyag-humusz-polimer (AHP) alapú trágyakészítmények felhasználására homoktalajon. Agrokémia és Talajtan 14. 1-2 p.:17-27.

Kazó B. (1981): Homoktalajok melioratív javítása hígtrágya, barnaszén, zeolit dezaggregátumokkal. Agrokémia és Talajtan Tom 30. No. 1-2. p.: 199-201

Kazó B., Karucka A., Kocsis I. (1981): A talajok víz- és tápanyag-gazdálkodásának javítása hígtrágya, barnaszén, zeolit dezaggregátumokkal. Agrokémia és Talajtan Tom 30. No. 1-2. p.: 235-239

Kazó B., Karucka A., Kocsis I. (1983): Hígtrágyák besűrítéses kezelésének jelentősége talajtani és környezetvédelmi szempontból. Agrokémia és Talajtan Tom 32. No. 3-4. p.: 461-464

Kádár I. and Vass E. (1988): Napraforgó műtrágyázása és meszezése savanyú homoktalajon, Növénytermelés, Tom. 17. No. 3. p. 207-212.

Köhler M. (1989): Kedvezőtlen talajtulajdonságok csökkentése és hozamok növelése környezetkímélő ásványi és agyagos komposzt alkalmazásával. Agrokémia és Talajtan 38. p.: 231-234

Kreybig L. (1944): A Tiszántúl. Magyar Királyi Földtani Intézet Kiadás, Budapest. p.: 66-69, 93-104

Lazányi J. (1994): A homokjavító kísérletekkel végzett kísérletek eredményei. Debreceni Agrártudományi Egyetem Kutató Központja, Nyíregyháza p.:44-47, 181-184, 189-192

Márton Á. (1969): Különböző adagú és arányú nitrogén műtrágyák hatásának vizsgálata nyírségi homoktalajon. Agrokémia és Talajtan, 18. 2. p.: 255-260.

Nelson D. W. és Sommers L. E. (1996): Total Carbon, Organic Carbon, and Organic Method. in.: Methods of soil analysis, part 2. Chemical and Microbiological properties. 2nd edtion. 1982. SSA Inc. Madison. p.: 570-571.

Prettenhoffer I. (1981): Futóhomok-talajok javítása helyben kitermelhető anyagokkal. Agrokémia és Talajtan, 30. 1-2. p.: 196-198.

Stefanovits P. and Fekete J. (1984): A lápföldes homokjavítás értékelése. Agrokémia és Talajtan 33. 1-2. p.: 199-206.

Szemes I. and Kádár I. (1990): Műtrágyázás és meszezés tartamhatásának vizsgálata savanyú homoktalajon. Növénytermelés Tom. 39. No.2 p. 147-155

Szűcs I.(2004): Alkalmazott statisztika, Agroinform Kiadó Budapest.

Várallyay Gy. (1984): Magyarországi homoktalajok vízgazdálkodási problémái. Agrokémia és Talajtan 33. 1.-2. p.: 159-169.

Westsik V. (1951): Homoki vetésforgóinkkal végzett kísérletek eredményei. Mezőgazdasági Kiadó. Budapest.

RELATED PUBLICATIONS

Conference proceedings

In Hungarian

Szegi Tamás, Makádi Marianna, Hegymegi Péter 2003: Bentonit hatása a csemegekukorica (Zea Mays convar. Saccharata) termésére, nyírségi homoktalajon. IX. Ifjúsági Tudományos Fórum Keszthely, CD-rom

In English

B. Simon, J. Berényi-Üveges, Z. Horváth, **T. Szegi** 1999: $CaCO_3$ Eluviation and Precipitation Processes in Paleosols. Ph. D. Hallgatók II. Nemzetközi Konferencája, Miskolc, p:49-53.

T. Szegi, E. Michéli, E. Tombácz , J. Lazányi 2002: Improving rheological and adsorption characteristics of sandy soil by mineral colloids application. Alpok – Adria konferencia Opatija. p: 219-223.

Erika Michéli, Etelka Tombácz, **Tamás Szegi**, Anita Gál 2002: Relationship of Rheological Parameters and Erodibility of Soils, 12th International Soil Conversation Organization conference. Beijing, p: 110-115.

M. Fuchs, **T. Szegi**, E. Michéli 2004: Archeopedological Interpretation of Redox Processes. Alpok Adria Konferencia, Dubrovnik p: 393-397.

Erika Michéli, **Tamás Szegi**, Luca Montanarella 2004: Missing items for the developing European Soil Protection Strategy. ESSC konferencia Budapest. p: 313-316.

Tamás Szegi, Anita Gál, Erika Michéli, Etelka Tombácz 2004: Quantitative Rheological Parameters for Predicting Soil Deformation. Eurosoil Conference Freiburg. CD ROM.

Krisztina Kovács, **Tamás Szegi**, Etelka Tombácz 2006: Structural improvement of sandy soils: experiences from a Hungarian remediation and suggestions from rheological investigations of model systems. Proceedings of the 13th Meeting of the International Humic Substances Society, - Karlsruhe, Germany, Humic Substances – Linking Structure to Functions (Eds. F.H.Frimmel, G.Abbt-Braun) Universitat Karlsruhe (TH), p: 581-584.

Anita Gál, **Tamás Szegi,** Erika Michéli, Etelka Tombácz, Ádám Zsolnay, Junko Akagi 2006: Role of organic matter in the development of stable soil aggregation on a Chernozem soil – a case study. Proceedings of the 13th Meeting of the International Humic Substances Society – Linking Structure to Functions (Eds. F.H.Frimmel, G.Abbt-Braun) Universitat Karlsruhe (TH)**,.** p: 697-700. Karlsruhe, Németország

B. Szeder, B. Simon, M. Dombos, **T. Szegi** 2007: Biological Investigation on an Erosion Catena. Joint International Conference on Long-term Experimnets, Agricultural Research and Natural Resources, Debrecen – Nyírlugos p.: 357-363.

Conference abstracts

In Hungarian

Szegi Tamás, Makádi Mariann 2003: Bentonit hatása a talajok tulajdonságára, különös tekintettel az aggregátum stabilitásra és ezáltal a terméseredményekre, zöldborsó és csemegekukorica esetében. Tavaszszél konferencia, Sopron, CD-rom

Szegi Tamás, Michéli Erika, Tombácz Etelka, Gál Anita 2004: Az ásványi – szerves komplexumok talajjavító hatásának kutatása, különös tekintettel a mikroaggregátumok stabilitására és a tápanyagok adszorpciós megkötődésére. Talajtani Vándorgyűlés, Kecskemét. Augusztus 24-26

Michéli Erika, Fuchs Márta, **Szegi Tamás**, Szabóné Kele Gabriella 2004: A nagy agyagtartalmú talajok osztályozási problémái. Talajtani Vándorgyűlés, Kecskemét. Augusztus 24-26

Szegi Tamás, Hegymegi Péter, Waltner István, Micheli Erika 2006: Javaslatok a barna erdőtalajok osztályozásának módosítására. Talajtani Vándorgyűlés, Sopron. 2006. augusztus 23-25. p.62.

Hegymegi P., **Szegi T**., Szeder B. 2007: Az erózió európai szintű nyomon követésének tervezése az ENVASSO projektben. Tájökológiai lapok. 5. (1). p. 206-207.

Bialkó Tibor, **Szegi Tamás**, Fuchs Márta, Láng Vince 2009: A magnézium megjelenése és jelentősége a talajokban, és a talajok osztályozásában. 11. Magyar Magnézium Szimpózium, Corvinus Egyetem, Budapest.

In English

T. Szegi, E. Michéli, E. Tombácz, A. Gál, J. Lazányi 2002: Rheological and Adsorption Properties of Sand-Clay Complexes. Amerikai Talajtani Társaság (Soil Science Society of America) Indianapolis poszter

A. Gál, E. Michéli, E. Tombácz, **T. Szegi** 2002: Impact of Soil Degradation on Organic Matter and Aggregate Stability Amerikai Talajtani Társaság (Soil Science Society of America) Indianapolis

A. Gál, E. Tombácz, T. Vyn, E. Michéli, **T. Szegi** 2003: Impact of Tillage on Organic Matter and Aggregate Stability. Amerikai Talajtani Társaság (Soil Science Society of America) poszter

Fuchs Márta, **Szegi Tamás**, Michéli Erika 2004: Influence of Sarmata burial customs on changes of soil redox conditions. Paleosolos: Memory of acient landscapes and living bodies of present ecosystems. Florence, Italy. p: 31-32

Tamás Szegi, Erika Michéli, Márta Fuchs, Gabriella Kele, Miklós Vajdulák 2004: Charachterization and classification high smectite clay content soils in Hungary. Soil Classification 2004 International Conference and Field Workshop. Petrozdavoszk.

Fuchs Márta, **Szegi Tamás**, Michéli Erika 2004: Redox Iron Pan Interpretation in an Archological Site in Hungary. ASA-CSSA-SSSA International Annual Meetings, Seattle, USA.

M. Fuchs, **T. Szegi**, E. Michéli 2005: Genesis and Classification Problems of Vertisols in Hungary. 2005 ASA-CSSA-SSSA International Annual Meetings, Salt Lake City, USA.

Anita Gál, **Tamás Szegi**, Barbara Simon, Balázs Szeder, Erika Michéli, Etelka Tombácz, Ádám Zsolnay, Junko Akagi 2006: Indicators of soil degradation processes on a Chernozem field in Hungary. ASA-CSSA-SSSA International Annual Meetings, Indianapolis, USA.

B. Szeder, B. Simon**, T. Szegi** 2007: Biological and physical indicators of soil erosion. 5th International Congress of the European Society for Soil Conservation. Changing Soils in a Changing World: the Soils of Tomorrow. Palermo, p. 292.

Barbara Simon, Balázs Szeder, Márta Fuchs, Antonio Bispo, Erika Michéli and **Tamás Szegi** 2008: Testing Monitoring Methods for Soil Organic Matter and Soil Biodiversity on European and National Scales. Hungary. ASA-CSSA-SSSA International Annual Meetings, Houston, USA.

Refereed manuscripts

In Hungarian

Szegi Tamás, Michéli Erika, Gál Anita, Tombácz Etelka 2004: Művelt mezőségi talajok szerkezeti stabilitásának jellemzése a reológia módszerével. Agrokémia és Talajtan, Vol 53. p.:239-250 Budapest

Fuchs M., **Szegi T.**, Michéli E. 2006: Szarmata temetkezési szokások hatása a talajok redox viszonyainak megváltozásra – Az ülői szarmata fazekasfalu példáján. Tájökológiai lapok, 4. p.:69-177. Gödöllő

Szeder B., Simon B., Dombos M., **Szegi T.** 2007: Biológiai és biokémiai vizsgálatok egy eróziós katénán. Talajvédelem, különszám. p.: 75-82.

Szegi T., Czibulya Zs., Makádi M., Szeder B. 2008: Szerves – szervetlen adalékanyagok hatása a nyírségi homoktalajok talajszerkezeti, nedvességgazdálkodási tulajdonságaira és a terméseredményekre. Talajvédelem, különszám. p.:163-168.

In English

T. Szegi, E. Michéli, E. Tombácz 2005: Improving management properties of sandy soils by organo-mineral additives. Cereal Research Communicatons Proceeding of the IV. Alps-Adria Workshop Vol.33 No.1 p.: 353-356. (IF< 0,3)

M. Fuchs, E. Michéli, **T. Szegi,** P. Hegymegi 2006: Transport processes within Vertisol pedons. Cereal Research Communications, Vol. 34 No. 1. p:179-182. (IF, 1,037)

Tamás Szegi, Etelka Tombácz, Zsuzsanna Czibulya, Junko Akagi, Adam Zsolnay 2006: Quantitative Rheological Indicators for Soil Physical Degradation Agrokémia és Talajtan. Volume 55. Number 1. p.: 69-78.

B. Szeder, B. Simon, M. Dombos, J. Akagi, **T. Szegi** 2006: Biological and biochemical investigation on an erosion catena, V. Alps-Adria Scientific Workshop Opatija, Croatia, 6-11 March, p.: 307-310. (IF, 1,037)

B. Szeder, M. Makádi, **T. Szegi**, A. Tomócsik, B. Simon 2008: Biological and agronomic indicators of the impact of fieldscale bentonite application. VII. Alps-Adria Scientific Workshop, Stara Lesna, Slovakia, p.: 911-914.

Márta Fuchs, Tünde Nyilas, **Tamás Szegi,** Tibor Bialkó 2008: Morphological evidences of swelling stress in some high clay content soils of Hungary. VIII. Alps-Adria Scientific Workshop, Neum, Bosnia – Hercegovina p. 435 – 438.

Zs. Czibulya, E. Tombácz, **T. Szegi**, E. Michéli, Á. Zsolnay 2009: Rheology as a new tool indicating structural changes in Soil Catenae (in preparation European Journal of Soil Science, IF: 2,73)

Zs. Czibulya, E. Tombácz, **T. Szegi**, E. Michéli, Á. Zsolnay 2009: Adaptation of rheological method to monitor the efficiency of soil remediation (in preparation European Journal of Soil Science, IF: 2,73)

Other

Szegi Tamás 2000: Erózióvédelmi eljárások tervezés a SzIE Józsefmajori Kísérleti és Tangazdaságában. TDK. dolgozat, Gödöllő

Michéli E., Gál A., **Szegi T**., Tombácz E. 2002: A szerves és szervetlen összetevők szerepe a talaj mikroszerkezetében. Budapest, A Nemzetközi Humuszanyag Társaság (IHHS), Magyar Tagozata (Hungarian Chapter) "Humuszanyagok a környezeti rendszerekben" c. Szimpóziuma. Presentation.

Szegi Tamás, Hegymegi Péter, Tombácz Etelka, Michéli Erika 2004: Szervesanyag szerepe a talajokban és a környezetgazdálkodásban. A Nemzetközi Humuszanyag Társaság (IHHS), Magyar Tagozata (Hungarian Chapter) Szimpóziuma. Presentation.

Gál Anita, **Szegi Tamás**, Michéli Erika 2005: Szerves anyag gazdálkodás művelt talajokban. Nemzetközi Humuszanyag Társaság (IHSS), Magyar Tagozatának szimpóziuma. Presentation.

Michéli Erika, Gál Anita, **Szegi Tamás**, Árvay Gyula, Sz. Kele Gabriella, Berényi-Üveges Judit 2008: Szervesanyag és biodiverzitás monitorozása tábla, nemzeti és EU-s szinten. Nemzetközi Humuszanyag Társaság (IHSS), Magyar Tagozatának szimpóziuma, Karcag, október 30. Presentation.