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INFLUENCE OF SOIL BIO STIMULATORS ON THE CHANGE IN THE QUALITY OF A SOIL TILLAGE MACHINE OPERATION

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Фіндура П., Пріставка М., Хурда В., Шпарага А., Щур Т., Габрієль Ю., Сало Я. Вплив біостимуляторів ґрунту на зміну якості роботи землеобробних машин
В умовах Словаччини за останні сто років відбулася значна деградація сільськогосподарських угідь. Часті зміни важкої сільськогосподарської техніки спричинюють ущільнення ґрунту, а відсутність органічних речовин у ґрунті впливає на зміну якості ґрунту. На сьогодні екологічна проблема в сільському господарстві посідає важливе місце у зв'язку з падінням рівня родючості ґрунтів, тому є актуальним обґрунтування різних способів обробітку ґрунту. Це стосується не тільки вивчення їхнього впливу на агрофізичні і агрохімічні властивості ґрунту, а й на біологічну активність ґрунту, від якої великою мірою залежить ефективна і потенційна родючість. У компанії Agrotechna Michalovce було проведено досліди. Застосовано пробний варіант біостимулятора Neosol 150 кг га$^{-1}$ у піддослідний ґрунт, за технологією захисту ґрунту, а друга половина культивувалася звичайно, без біостимулятора. Неозол-біостимулятор – препарат, що містить природні речовини на основі мінеральних мікро- та макроелементів та домішок органічних речовин, як засіб, що забезпечує поліпшення властивостей ґрунту за відсутності органічних речовин у ґрунті, який після основного внесення в ґрунт стимулює основні природні процеси, важливі для оптимального росту та розвитку рослин. На основі простого аналізу результатів вимірювання опору на розтяг і витрат палива підтверджено той факт, що була поліпшена функція біологічної активності і, отже, структура ґрунту знизила стійкість до розтягу на 9,85 %, зменшила загальне перетворене споживання праці приблизно на 15,5 % і зменшила споживання пального на гектар приблизно на 23 %.
Ключові слова: ґрунт, властивості ґрунту, біостимуляція, стійкість ґрунту до розтягування.

Findura P., Prístavka M., Hrdá V., Szparaga A., Shchur T., Gabriel Y., Salo Ya. Influence of soil bio stimulators on the change in the quality of a soil tillage machine operation
In the conditions of Slovakia there has been considerable degradation of agricultural land over the last hundred years. Frequent changes of high-weight agricultural machinery have caused soil compaction and the missing organic matter in the soil also affects soil change. Currently, the environmental problem in agriculture takes an important place in connection with the decline in soil fertility. Therefore, it is important to justify the various methods of tillage. It involves not only study of their influence on the agrophysical and agrochemical properties of soil, but also on the biological activity of the soil, on which the effective and potential fertility largely depends. The experiment was established in Agrotechna Michalovce company. The trial variant with the Neosol 150 kg. ha^{-1} bio stimulator was based on the soil we had been working, with the soil protection technology and the second half was cultivated conventionally without the bio stimulator. Neosol-biostimulator is a agent containing natural substances based on mineral micro and macronutrients and admixtures of organic substances, as an option improving soil properties under the absence of organic matter in the soil, which after basic application to the soil stimulate basic natural processes important for optimal plant growth and development. Based on simple analysis of the results of measurement of the tensile resistance and fuel consumption, it is confirmed that the improved function of biological activity and consequently the soil structure cause a decrease of tensile resistance by 9.85 %, fall of the total converted labour consumption by approximately 15.5 % and decrease of consumption of oil per hectare by approximately 23 %.
Key words: soil, soil properties, bio stimulation, tensile resistance of soil.

Introduction. Proper land management is very important for water retention in nature. The current agricultural management is increasingly focused on land maintenance and land use [5; 9; 10]. It is very important, literally the most important part of agriculture. Therefore, it is necessary to care for the soil and its biodiversity [8; 11; 13; 17]. Soil provides plants with everything needed, but at the same time

the activity of microorganisms arises. So, it is not the soil which creates plants but the plants create the soil [12]. Thus, it is very important to study relationship between various plants, plants and soil and environmental impacts. After application, soil bio stimulus very rapidly initiate an increase in biological activity in the soil [1; 7; 14–16]. Consequently, the degraded soils also improve physical properties of soil in particular by improving its structure and porosity, and reducing soil stiffness. In the area of chemical characteristics, it especially increases the proportion of organic soil components [6].

As a result, it means optimizing the proportion of soil fractions to improve water and air regime.

In case of using soil bio stimulus, share of organic soil component demonstrably increases especially due to the increase in the biomass volume of the roots (up to 300 %) and increase of microorganisms and macroorganisms in soil by up to 200 %.

Material and methods. The research was done [2; 3] on one parcel, divided into two parts. One part was treated with the Neosol at 150kg.ha^{-1} applied in [2; 3; 12], one part was control, where NPK 15:15:15 fertilizer was applied at 200kg.ha^{-1}.

Among the soil properties we monitored:

- type of soil,
- soil condition,
- soil structure,
- soil specific gravity,
- infiltration,
- soil porosity,
- soil moisture,
- soil penetrometric resistance.

By the method of measuring soil structure, we mean measuring the size of lumps. Samples were taken from two depths, namely 0 – 0,15 and 0,15 – 0,30 m in three rounds. The structural coefficient was calculated for the self-evaluation, expressing the relationship between agronomically valuable (0,25 – 10 mm) and less valuable structural elements (> 10 and < 0,25 mm) states, that the best emergence of spring barley was achieved by covering the seeds with the fines aggregates. In his results he indicates, that the seed should be sown to a depth of about 40 mm and the lumps covering it, should be 50 % less than 5 mm. In [4] evaluates the degree of fragmentation by changing the specific area of the aggregates and the mean weighted diameter of the lumps as MWD (mean weight diameter). The specific area of the aggregates is expressed as the area per n unit of mass of the individual fragments. A is calculated from the individual weights of the soil aggregates obtained by sieving according to the formula:

$$A = \frac{6}{\rho G} \sum_{i=1}^{n} \frac{w_i}{(d_i d_{i+1})^{1/2}}, \quad (1)$$

where w_i – is weight of sifted aggregate [g] between two neighbouring holes of the sieve and d_{i+1}; G – is the total weight of the sample; n – is the number of sieve; ρ – is the soil mass density.

MWD is calculated by the following formula:

$$MWD = \frac{\sum_{i=1}^{n} w_i \overline{d_i}}{G} \quad (2)$$

$$\overline{d_i} = \frac{1}{2}(d_i + d_{i+1}) \ . \quad (3)$$

It is also stated, that within soil preparation in spring, the size of lumps depends on the soil condition and also on the content of clay particles [4].

Tensile resistance measurements were made after three years of Neosolu application, during plowing operation with a 5 pieces plow to a depth of 30 cm with a strain gauge in both parts of the plot treated with the preparation and on the control part. The tensile support measuring kit contained measuring instruments and devices (Tractor John Deere 7930, semitrailer plow 5PHX 35 and measuring system Hottinger Baldwin Messtechnik Spider-8). The measurements were made on the parcel and with the product to be treated and the control part. The device records tensile resistance in kN at intervals of 0,2 s.

Fig. 1. View of the measuring device Hottinger Baldwin Messtechnik Spider-8

Results and discussion. The soil bio stimulus initiates an increase of biological activity of soil subsequently and very quickly after application, the degradation of soils also leads to an improvement in physical soil properties, in particular an improvement in the soil structure, a reduction in soil compaction and an improvement in porosity.

The given field experiments showed the increasing influence of bulk density, both in the control and on the plot where NEOSOL was used, the significant increase of the value above 60 mm increases linearly. The maximum volume density of 2.041t.m^{-3} was reached during the control. The NEOSOL variant reached the maximum value of 1.891 t.m^{-3}. With regard to soil moisture we can conclude that there were no significant differences between the individual variants with controls and NEOSOL.

In the whole soil profile horizon after application of the soil bio stimulus Neosol, there are the root residues observed, which were also more prominent in the loess zone.

In the transition zone from 40 cm in the profile treated by bio stimulus, there is also more visible shift of organically stable substances towards the loess, i. e. confirmation of positive change of soil physical parameters with subsequent more even movement of water and nutrients throughout the profile.

On the plots where measurements were made, the value of the structural coefficient KS = 5,04 at Control and Neosol, was 5,03, there is clearly a low proportion of soil granulates in the dimensions of 8 – 16 mm, which is typical for sandy (light) soils.

For measuring tensile resistance 5-piece plow at a depth of 30 cm with built-in strain gauge was used. The plot was divided into two parts during the measurement and we performed two repetitions for each variant.

On a site, which served as a control during the first pass, the total tensile resistance amounted to 83 685 kN. At the next pass number two, the measured value was 84 648 kN.

In the experimental variant, where NEOSOL was applied, we measured lower values compare to the control. During the control without preparation, the maximum tensile resistance showed a value of 78 812 kN, in the second round the value was 77 923 kN.

Based on a simple analysis of results of tensile resistance and fuel consumption, we confirmed the fact that under the improved function of biological activity and consequently soil structure, the tensile resistance was reduced by 9.76 %, the total converted labour consumption was reduced by approximately 14.3 % and the oil consumption per hectare was reduced by approximately 23 %.

Table. Results of soil density, soil moisture

Volume of dry soil weight, t/m^3	Moisture, %	Place
1,758	14,47	NEOSOL
1,667	14,58	NEOSOL
1,891	15,44	NEOSOL
1,902	13,92	CONTROL
1,910	12,48	CONTROL
2,041	13,78	CONTROL

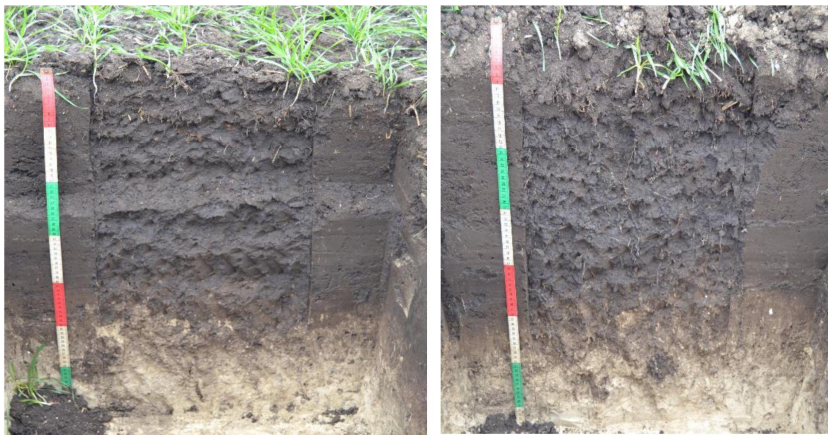

Fig. 2. Comparison of soil profiles: left Control, right Neosol

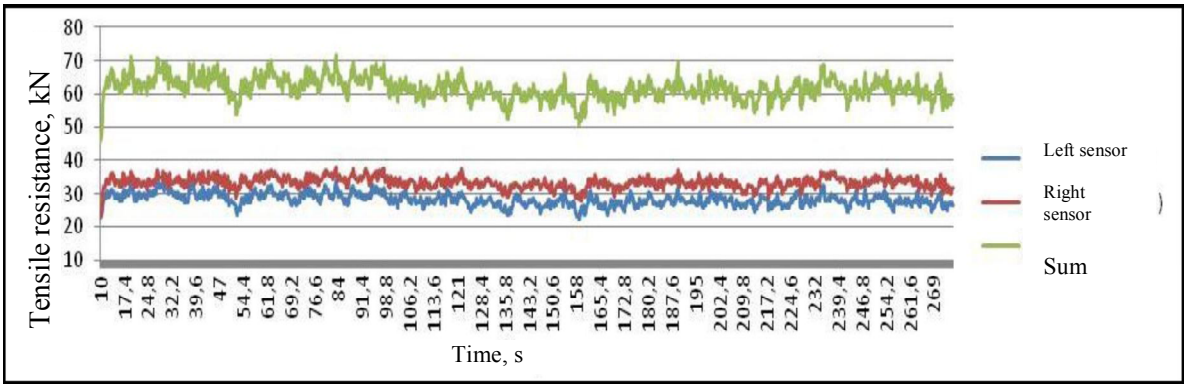

Fig. 3. Tensile resistance measurement record

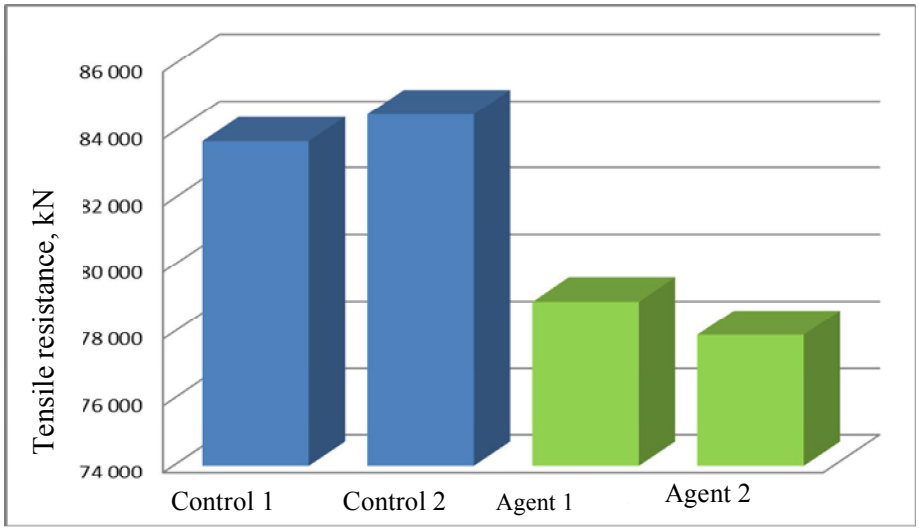

Fig. 4. Comparison of tensile resistance within individual variants

Conclusion

To sum up we can state, that based on a simple analysis of the results of the measurements of tensile resistance and fuel consumption, we confirm the fact that the functions of biological activity and consequently the soil structure have improved, also the tensile resistance has decreased and thus, the total recalculated labour consumption decreased. We also recorded a reduction of oil consumption per hectare. When evaluating the harvested wheat, it was noted that they were in favour of Neosol technology where, after three years of application, the crop increased as compared to the control. Concerning winter wheat, the difference was in favour of biostimulation was 1,2 $t.ha^{-1}$. This is due to the changes in soil properties and more efficient use of nutrients in the soil. Biostimulation helps to initiate microbial life in the soil.

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