The Balkans Scientific Center of the Russian Academy of Natural Sciences

3rd International Symposium:

Modern Trends in Agricultural Production Rural Development and Environmental Protection

Vrnjacka Banja, Serbia
July, 01-03. 2021.

Modern Trends in Agricultural Production
Rural Development and Environmental Protection

Publisher
The Balkans Scientific Center of the
Russian Academy of Natural Sciences
Belgrade

In cooperation

Faculty of Agriculture, Lesak
Faculty of Agriculture Cacak
Institute for Animal Husbandry, Belgrade, Zemun
Fruit Research Institute, Cacak
Faculty of Agriculture, East Sarajevo
Soil Science Institute, Belgrade
Faculty of Hotel Management and Tourism,Vrnjacka Banja

Editor

Acad. Prof, dr Mitar Lutovac
Prof. dr Zoran Ž. Ilić

Technical editor
Zoran Stanisavljević, SaTCIP

ISBN
978-86-6042-012-3

Circulation
100 exemplars

Printed by
SaTCIP d.o.o. Vrnjačka Banja

Belgrade, 2021.

INTERACTION OF BIOLOGICAL INDICATORS OF LAND WITH PLANTS YIELD

Ivana Bošković[1], Dragutin Đukić[2], Leka Mandić[2], Aleksandra Govedarica Lučić[1], Vesna Milić[1], Igor Đurđić[1]

[1]University of East Sarajevo, Faculty of Agriculture,Vuka Karadžica 30, Bosnia and Herzegovina
[2]University of Kragujevac, Faculty of Agronomy, Cara Dušana 34, Čačak, Serbia

Abstract: *The paper studies the relationship between the basic biological processes that take place in the soil and the yield of some agricultural crops.*
A pronounced correlation was found between the size of the yield and the degree of soil humification, respiration intensity, cellulolysis, nitrification, invertase and urease activity, as well as the degree of nitrogen accumulation, the presence of sporogenic bacteria and actinomycetes.
Keywords: *enzymes, microorganisms, yield, humus, soil.*

INTRODUCTION

In the last few decades have been published many papers which have pointed to a link between the many biological processes that take place in soil and yield of crops (Verstraeten, 2008; Domsch, 2007., Andreeva et al., 2001; Mandić et al., 2011; Romejko, 2008; Stefanjkina, 2008; Čunderova, Zubec, 2000). The relationship with invertase activity is particularly close (Vizemjuller et al., 2008; Galstjan, 2004). The connection between enzymes that mineralize nitrogenous organic compounds (protease, urease) and crop yields was also determined (Pešaković et al., 2008; Verstraeten, 2008; Iljina et al., 2007; Dubovenko, Ulasević, 2008). The level of connection of yield with enzyme activity in soil is higher than with agrochemical indicators (Đukić et al., 2007; Čunderova, 2002).

There is a positive correlation between the yield of winter rye and celulolizne activity area (Krause, 1999), the size of the yield, the total number of microorganisms, accumulation of free amino acids and the intensity of the nitrification (Kislih et al., 2005).

MATHERIAL AND METODS

In this paper, standard methods were used to determine the amount of humus in the soil, the number of the most important physiological groups of microorganisms (ammonifiers, nitrifiers, oligonitrophils, actinomycetes, yeasts), basic biological processes (cellulose decomposition, CO2 release, nitrification intensity, free amino acid accumulation). activities (catalase, dehydrogenase, polyphenol oxidase, invertase, urease, asparaginase).

RESULT AND DISCUSSION

The results of the research show that there is a connection between barley yield and biological indicators of sod-podzolic sandy and clayey soil in the vegetation-field experiment (Table 1, 2).

Table. 1. Relationship between humus content, barley yield and biological properties of sod-podzolic soil

Biological indicators	**Correlation relations**			
	sandy		Clayey	
	humus	yield	humus	Yield
	1,68-3,25 %	33,58-134,1 %	1,90-3,81 %	66,35-132,52 %
Ammonification bacteria	Unreliable	0,45	Unreliable	0,49
Sporogenic bacteria	0,96	0,77	0,90	0,53
Yeasts	0,69	0,59	Unreliable	Unreliable
Actinomycetes	0,80	0,54	0,84	Unreliable
Oligonitrophiles	0,86	0,85	Unreliable	Unreliable
Potential nitrogen activity	0,85	0,70	0,61	Unreliable
Nitrification aktivity	0,93	0,85	0,92	0,59
Cellulolytic activity	0,75	0,63	0,80	0,63
Accumulation free aminoacids	0,61	Unreliable	0,47	0,66
Dehidrogenase	0,98	0,88	0,73	Unreliable
Polyphenoloxidase	0,91	0,86	0,95	0,70
Invertase	0,95	0,85	0,45	Unreliable

Judging by the correlation relations, in most biological tests, determined in sandy soil, there is a high degree of correlation between humus content and barley yield (Table 1). On clay soil, the connection between barley yield and sporogenic bacteria, nitrification and cellulolysis ability and polyphenol oxidase activity is especially pronounced. In soils of barley production crop, the connection between yield and activity of invertase, polyphenol oxidase and CO2 release is especially pronounced (Table 2).

Based on the above, it can be concluded that microbiological and biochemical processes accurately enough manifest the state of fertility of the podzolic soil type and can serve as good indicators.

Comparative analysis of the studied biological tests to detect the leading processes in the examined soils showed that the most precise characteristic of the biological activity of soils from the group of oxido-reduction enzymes is given by polyphenol oxidase, and from the group of hydrolases - invertase. There is a clear agreement between the size of the yield, the degree of humification of the soil and the intensity of "breathing", cellulolysis and nitrification ability and the content of sporogenic bacteria.

Table. 2. Relationship between biological properties of sod-podzolic soil and barley yield

Indicators	Correlacioni relation			
	Sandy		Clayey	
	2008. year	2009. year	2008. year	2009. year
Limits of variation of barley yield, 100 kg/ha of yield	26,0-58,0	20,8-39,1	36,8-65,3	16,0-37,0
Invertase	0,24	0,40	0,43	0,43
Polyphenol oksidase	0,24	0,35	0,30	0,34
CO_2 emission	-	0,40	-	0,59
Potential nitrogen fixation activity	-	Unreliable	-	0,32
Nitrification activity	-	0,32	-	Unreliable

Based on the analysis of the correlation of protease, urease, polyphenol oxidase, dehydrogenase and invertase with the yield of winter rye and potatoes, a mathematical model was developed that describes the relationship between yield and enzyme activity in soil (Čunderova, Zubec, 2010). This means that there is a possibility of predicting the yield of agricultural crops based on the enzymatic activity of the soil.

Very reliable correlations have been established which characterize the connection of certain biological indicators with the yield of some vegetable crops, such as cabbage and cucumber (Table 3). There is a particularly close relationship between yields with a group of sporogenic bacteria, with bacteria that use mobile nitrogen, with actinomycetes, with the intensity of nitrate accumulation in the soil, cellulose decomposition, invertase and urease activity.

Table.3. Correlation analysis of the relationship between biological indicators and yield

Biological indicators	**2009. year - cabbage**			**2009. year - cucumber**		
	r	η	$\eta^2 \cdot 100$	r	η	$\eta^2 \cdot 100$
MIKROORGANISMS						
Ammonification bacteria	0,75	0,86	74	0,13	0,33	11
Sporogenic bacteria	0,71	0,85	72	0,95	0,98	96
Nitrogen fixers	0,44	0,72	52	0,02	0,80	64
Actinomycetes	0,58	0,76	58	0,29	0,73	53
Nitrifiers	0,85	0,86	74	0,50	0,53	29
Yeasts	0,42	0,52	27	0,08	0,46	21
BIOLOGICAL PROCESSES						
Nitrate accumulation	0,58	0,76	58	0,13	0,62	38
Amino acids	0,76	0,69	48	0,37	0,46	21
Cellulose degradation	0,79	0,93	86	0,75	0,79	62
ENZYME ACTIVITY						
Catalase	0,54	0,54	29	0,49	0,68	46
Invertase	0,59	0,59	35	0,41	0,76	58
Urease	0,60	0,65	42	0,21	0,56	58
Asparaginase	0,65	0,65	42	-	-	-

CONCLUSION

The number and activity of microorganisms in the soil are good indicators of the condition of the soil, which especially refers to the activity of invertase and polyphenol oxidase.

There is a clear relationship between yield size, degree of soil humification and respiration intensity, cellulolysis and nitrification activity, and the presence of sporogenic bacteria.

Strong correlations were found between the yield of some agricultural crops and sporogenic bacteria, actinomycetes, cellulose degradation, degree of nitrogen accumulation, invertase and urease activity.

REFERENCES

Andreeva, D.M., Detkovskaja, L.P., Tarasenko, S.A. Nitrifikacionnaja aktivnost počvi i urožaj jarovih zernovih kuljtur. Vknige: Prijomi povišenija plodorodija počv v Bellorussli. Tez. Dokl. nauč-proizv. konf. 2001, p. 80-83.

Romejko, I.N., Bitjukova, L.K., Zil, L.M. Vzuimosvjaz pokazatelej biologičeskaj aktivnosti dernvvo-podzolistoj počvi s urožajami seljskohozjajctvennih kuljtur. Vknjige: Mikrobiologičeskie processi v počvah i urožajnost seljsko-hozjajstvennih kuljtur. Mater. k respublikanskoj konf. (6-7 ijulja 2008. god). Viljnus, 2008, p. 289-290.

Stefanjkina, L.M. Zavisimost urožaja jačmenja at soderžamija gumusa i biologičeskoj aktivnosti dernovo-podzolistoj supesčanoj počvi: Avtoref. dis. kand. s-h nauk. Riga, 2008. p.16.

Đukić, D., Jemcev, V.T., Kuzmanova, J. Biotehnologija zemljišta, Budućnost, Novi Sad, 2007, 529 str.

Pešaković, M., Đukić, D., Mandić, L., Cvijović, M., Aćamović-Đoković, G. NPK-fertilization influences proteinaze activity in aluvial soil. Cereal Research Communications. Vol. 36, Part II, 2008, p. 675-678.

Mandić, L., Đukić, D., Beatović, I., Jovanović, Z., Pešaković, M., Stevović, V. Effect of different fertilizers on the microbial activity and productivity of soil under potato cultivation. African Journal of Biotechnology, Vol. 10, No. 36, 2011, p. 6954-6960.

Čunderova, A.I., Zubec, T.P. Matematičeskaja modelj prognozirovanija urožaja seljsko-kozjajstvennih kuljtur po aktivnosti počvennih fermentor. Vkn: Mikroorganizmi i produktivnost seljskogohozjajstva. Tez. dokl. Riga, 2000, p. 24-25.

Dossch, K.H. Biological aspects of soil fertility. Int. Semin. Soil Environ. and Fertil. Manag. Intensive Agr. Tokyo, Kyoto.

Verstraeten, l.M. Interaction between urease activity and soil characteristics. Agrochimica. 122 (5-6), 2008, p. 1455-1464.
Vizemjuller, V.O. O korrelativnoj zavisnosti meždu biologičeskoj aktivnostju i kačestvom gumusa v počve pri dliteljnom primenenii udobrenij. Nauč. dokl. Visš. šk. Biol. nomki, 2008, No. 5, p. 130-143.
Galstijan, A.Š. Fermentativnaja aktivnost počv Armenenii -Erevan, Ajastan, 2004. p. 275.
Iljina, T.K., Negru-Vode, V.V., Vasilenko, E.S. Vlijanie udobrenij na aktivnost mikrobiologičeskih i fermentativnih processov prevrešćenija azota v dernovo-podzolistoj počve. Tez. dokt. XV deleg. sjezda Vsesojuz. ob.-va počvovedov Mn.2007, vip. 7, p. 738-739.
Dubovenko, B.K., Ulasevič, E.I. Izučenie aktivnosti nekotorih fermentov v prikorennoj počve seljsko-kozjajstvennih rastenij. Dokladi Simpoz po fermentom počvi, mn, 2008, 420-426.
Čunderova, A.I. Fermentativnaja aktivnost dernovo-podzolistih počv severozapadnoj zoni: Avtoref. diss. dokt. biol. nauk. Tortu, 2002, p. 26.
Krause, O. Der Einfluss einer winterbichen Stallmistkopfdiingung anf einige Faktoren der Bodenfruchtbar keit, Inssuesondere auf die zellulolytich Aktivitat des Bodens. Tagungsher. Disch. Akad. Landwirtschaftswiss, Berlin, 1999, p. 1257-1262.
Kislih, E.E., Laginova, M.M., Perverzer, V.N. Vlijanije okuljturivanija podzolistih počv Koljskogo poluostrva na ih azotnij rezim i biologičeskuju aktivnost. Agrohimija, 2005, No. 8, p. 10-13.
Čunderova, A.I., Zubec, T.P. Matematičeskaja modelj prognozirovanija urožaja seljsko-kozjajstvennih kuljtur po aktivnosti počvennih fermentor. Vkn: Mikroorganizmi i produktivnost seljskogohozjajstva. Tez. dokl. VI sjezda mikrobiolog. Ob-va. Riga, 2010, p. 24.