







VYTAUTAS MAGNUS **UNIVERSITY** AGRICULTURE ACADEMY

THE BIO-EFFECT ON COMPLEX OF DIFFERENT CHARACTERISTICS OF SOIL, TILLAGE AND YIELD IN CROP PRODUCTION

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INTRODUCTION

Different environmental analyses show that agricultural activities are one of the many local and global emissions sources (Notarnicola et al., 2017; Robertson et al., 2000). The agricultural sector is facing increasing public expectations regarding global environmental impact (Houshyar et al., 2017; Chen et al., 2010). Agriculture, forestry and other land use (24% of global greenhouse gas emissions): greenhouse gas emissions from this sector mostly come from agriculture (cultivation of crops and livestock) and deforestation. This estimate does not include the CO2 that ecosystems remove from the atmosphere by sequestering carbon in biomass, dead organic matter, and soils, which offset approximately 20% of the emissions from this sector. Crop production – one of the most important, expensive and fuel–consuming processes in agriculture. Thus, the use of strategically mixed compositions replaces the properties of soil and reduces fuel consumption during soil tillage and environmental pollution. The application of an innovative method in crop production can reduce CO₂ (Fig. 1) and



MATERIALS AND METHODS

Estimation of control (SC1) and different bio-impact scenarios (SC2 - SC8) were performed in deeply lukewarm soaked soil fields (Endohypogleyic-Eutric Planosol – PLe-gln-w) at the southwest side of Kaunas city, on the left side of the Nemunas river (54 $^{\circ}$ 534 N + 23 $^{\circ}$ 50 'E). In spring, when the vegetation of plants is renewed, winter wheat (in the first and second year) and oilseed rape (in the third year) culture fields affected by seven types of different bio-solutions from SC2 to SC8 scenario, which consist of water, essential oil, extracts of various grasses, extracts of sea algae, mineral oils, Azospirillum sp., Frateuriaurenticus, Bacillus megaterium, Azotobacterchroococcum, Azospirillumbrasilense, phosphorus, potassium, Azotobacter vinelandii, humic acids, gibberellic acid, copper, zinc, manganese, iron, calcium (spray rate 1.0 to 4.0 l ha-¹ by mixing with 200 l of water) (Table 1).

a set i bute to the implementation	an enterpoint of development of EU	an innovative method in ch	aliging and logislations, which would arout	Season	Operations	SC1 SC2 SC3 f	SC4 SC5 SC6 SC7 SC8	There were carried out researches of
contribute to the implementation	100, renewal and development of EU e	environmental and chinate p	policies and legislations, which would create	u	Winter wheat "Ada" (2015)/ "Famulus" (2016))/rapeseed	+ + +	+ $+$ $+$ $+$ $+$	fuel consumption parameters of soil tillage
added value for Europe (IPCC	<i>2</i> , 2014).		There are many specialized	ntu	"Cult" (2017) seeding			machines, yield, soil density, total porosity,
	and a second second second	and an and a second sec	researches on the influence of different	<u> </u>	Herbicide spraying 2.0 Lha ⁻¹	+ + +	+ + + + +	humus, soil stability, soil moisture content.
Problem	Technology	Result	bio-impact on the various parameters in		Fertilization ammonium nitrate (N ₅₁) 200 kg ha ⁻¹	+ + +	+ + + + +	The evaluation used experimental research
			agriculture. Different bio-impact effects		Fungicide 0.81 L ha ^{-1} and growth regulator 1.2 Lha ^{-1}	+ + +	+ + + + +	data and the SAW mathematical method to
		States and taken because	various properties and the composition of		spraying			find the best-case scenario.
	Connotine State	ALCONT THE MEL	soil, plant residues, harvests, and		Biopreparations spraying	- + +	+ + + + +	- Assessment of the variability of energy
	Conding		technological processes, total Global	<mark>ы</mark>	Water spraying	+ + +	+ + + + +	consumption, productivity, soil factors
GHG	Second a second and a second a	Reduction of	warming potential as well as the	prii	Bio-Impact 1 (B11) Bio-impact 2 (BT2)	- + -		could be compared by multicriteria
emissions		GHG	interactions between different parts of the	S	Bio-impact 2 (BT2)		+	analysis by classification to three different
increase		emissions	soil, working machine tools, energy		Bio-impact 4 (BT4)		- +	groups). It was established that
			consumption and environmental pollution		1+2 Bio-impact		+	multicriteria accounting can help farmers
	Стор		with harmful gases.		1+3 Bio-impact		+ -	and the policy makers for sustainable
Soil tillage	care	Reduction of	To summarize wide coverage		1+4 Bio-impact		+	agricultural production control ensuring
operation in		fuel	investigations of various aspects of		Additional fertilization ammonium nitrate (N68) 140 kg	+ + +	+ $+$ $+$ $+$ $+$	access to safe, healthy and nutritious
agriculture		consumption	different bio-impact parameters the main		ha ⁻¹			(Skafa et al., 2018).
	Hanvest		objective – to identify the best-case bio-		Fungicide 0.3 Lha ⁻¹ and growth regulator 0.3 Lha ⁻¹	+ + +	+ + + + +	Identified that different bio-effect of
Solid soil	THEFT AND A THE		impact scenario by accounting for many	let	spraying $(1,1)^{1}$ (1,1) (1,1) (1,1)			agricultural practices could be oriented
surface		Dynamics of	criteria in several aspects. The aim - to		Additional fertilization urea (N ₄₆) 10 Lna ⁻¹ and	+ + +	+ + + + +	towards a reduction in fuel consumption,
covered with	and the second	soil	identify bio-effect on soil characteristics,	Su	Additional fertilization ammonium nitrate (N _{co}) 80 kg ha ⁻¹	+ + +	+ + + + +	followed by reductions in CO ₂ emissions
plant	Coll Colling of the second	properties	tillage and yield from environmental and		Harvest	+ + +	+ + + + +	from machinery, dynamics of soil
restaues	tillage	5	economic aspects.		Disc harrowing	+ + +	+ + + + +	composition, properties and yield.
Fig 1	and the second sec				Ploughing	+ + +	+ + + + +	
11g. 1								

RESULTS

	SC8	4 80 1	8.07	7 н	10.40	0 1–0r	, .	13 13	н					5	7 33					<u> </u>	الم		1	34	5 37		1												
	SC7	4.504	7.00		0.05	1.02	1	5 21							58.00						2.04					52	17	. 2.02	,									-+	
₹R	SC7	4.501	1.99	т 41 г. г.	9.05	1.25	1	5.51							56.00	0					3.04	12.0				33	.17					2.29		2.0					
E/	500	6.03	Π 8.	41 -	9.9	99 F.	1/	10.	09						50.0	0					0.	138 H			— •			5.41				-		.58					
D)	scs	4.00	8.98	H	10.8	0 F.I	9	16.5	54		_				57.0	0					4.	. 0 4 H				39.90		+		F 2.0:	·							-+	
IR	SC4	6.28	н 7.	98 H	11	.21 1	.14	15	5.94	H		_			50	8.33	_						11.93	H	— •				51.06						9				
ΤH	SC3	4.40 H	8.57	н	10.9	8 H.C	8	17.	23	н					58	3.67						4.41	Н					55.81				-		-2.33					
	SC2	5.20	1 8.3	3 н	10.2	21 H.	1	16.0)4	н					54.00						— 10. 	.63	н		 			60.	.60	 			_		2.201				
	SC1	4.50H	8.41	н	11.7	70 1 .	18	15.4	40	н					52.00					<u>⊢ 6</u>	1.53 н						55.51						2.45						
	()																																					
	SC8		18.0	3	H	13.	03	н	14.8	88	1.23		20.28		H						60.80						3.9	90H					50.32					<mark>-2.13</mark>	
R	SC7	7.40	н	10	5.28	H	1	3.76	1.4	1	18.6	4	н					52.00	0				-	6 !08	н					56.1	8					2.76			
EA	SC6	7.60	н	14.	20	н	13.1	76	128		19.94		H					53.00)				-	5. 184	н						69	0.22						<u>⊢1</u> .	8 <mark>8 </mark>
Υ	SC5	7.60	н	1	6.47	H	1	13.80	1 <mark>.</mark> 3	88	19.(05	H					52.	90				H	<u>3.9</u> 9	H					54.22					⊢1.	лн			
Z	SC4	6.30	н	14.34	4	н	15.9	96	1.25		19.59)	н					52.9	0				-	2.99 ¹						61.7	76					2	.0 <mark>0</mark> -1		
00	SC3	7.00	н	15.	04	н	15	5.84	1 <mark></mark> 2	6	18.9)3	н					53.	00				H	4.4 0	н					53.05					⊢-2.2	þ			
SE(SC2	6.80	н	14.7	75	н	16	5.24	1 <mark>.3</mark>	7	18.4	1	H					48.90				F	<mark>3.1</mark> ⊉							65.21		1				2	.4 3 ⊣		
• -	SC1	7.60	н	1	6.92	H	4	16.00	0	₽.4 2		19.50		н				48	8.60				-	3.9 9н						63	3.01					F	2.58		
	()																																					
	SC8	7.61	н	9.09	н	12.21	ŀ.	33	13.98	3 ⊢	4				51.0	0				⊢ _2	95					50.32	2				<u>⊢2.</u>	52							
	SC7	8.02	2 H	8.45	н	12.64	1.	.29	15.0)2	н				51	.70				ŀ	2.69						56.18						<u>3.7</u> 7						
AR	SC6	7.38	н	8.46	н	13.03	ŀ.	29	15.9	95	н				50).90				F	2.65							69.22	2			1			 4	.33 н			
ΥE	SC5	7.44	н	8.44	н	12.76	1.	87	15.2	2	H				48.20)				<u>⊢2.2</u> 8	8					54.22						2.66							
Ľ	SC4	7.60	н	8.46	н	15.6	54	1.36	1	15.16	н					49.90					3.7	713 H						61.76				-		⊢2.	5 1 H				
IRS	SC3	7.18	н	8.51	н	13.70	ł	.312	16.	.39	н				4	9.60				F	3.65	Н				4	53.05					⊢ <u>2.</u> (54						
E	SC2	6.24	н 7.	62 н		14.88	t.	315	15.4	9	H				47.90	0				<u>⊢2.4</u>	4						65.21					-		2.051					
	SC1	6.81	н	9.64	н	15.2	24	1-84	1	4.96	н				4	8.20				-	2.08						63	01						3.05					

Experimental research shows that different bio-effects of agricultural practices can be oriented towards a reduction in fuel consumption, followed by reductions in CO₂ emissions from machinery and changes in soil properties, dynamics of composition, yield and other parameters. A multicriteria assessment of the essential parameters would give farmers new opportunities for reducing fuel consumption and increasing agricultural production, thereby reducing the negative environmental impact of soil cultivation processes, increasing yields and improving soil. Of all the properties investigated, from a practical point of view, the selection of the most important of all the essential links, such as reducing energy and expenditure, reducing environmental pollution, improving soil, and increasing yields and productivity, is reasonable. The evaluation of the bioimpact effects in agriculture by accounting many criteria in several aspects was the main objective of the multicriteria assessment.

To select the best bio-impact for each criterion, the most important goal was to maximise, minimise, and optimise some of the values of the indicators by replacing the formulas. Multicriteria effectiveness was most pronounced after the first and third soil bio-impacts by solution of Azotobacter vinelandii bacteria, humic acids, gibberellic acid, copper, zinc, manganese, iron, calcium, and sodium molybdate.

■ Yield, t ha⁻¹ ■ Shallow tillage consumption, $1 h^{-1}$ ■ Deep tillage consumption, $1 h^{-1}$ ■ Density, g cm⁻³ ■ Humidity, % ■ Total porosity, % ■ CO₂, Mmol m⁻²s⁻¹ ■ Structural stability, % ■ Humus, %

CONCLUSIONS

- Conducted multicriteria consolidation of distinct soil bioimpact effects in agriculture and summarised wide coverage investigations of various aspects.
- Discovered one bio-impact for maximization values of yield, total porosity, humus, stability; minimization of ploughing and disc harrowing fuel consumption, density, CO₂ emission; optimization of moisture indicators.
- After the main evaluation of criteria based on scenario ratings, the data highlighted the most effective bio-impact after the first and third soil treatments, which consisted of Azotobacter vinelandii, humic acids, gibberellic acid, copper, zinc, manganese, iron, calcium, and sodium molybdate.





Less	Ploughing fuel consumption Disc harrowing fuel consumption	
1 More	Yield	
Less	CO_2 from soil Soil density	

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