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 CO_2 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 CO_2 (Fig. 1) and contribute to the implementation, renewal and development of EU environmental and climate policies and legislations, which would create added value for Europe (IPCC, 2014).

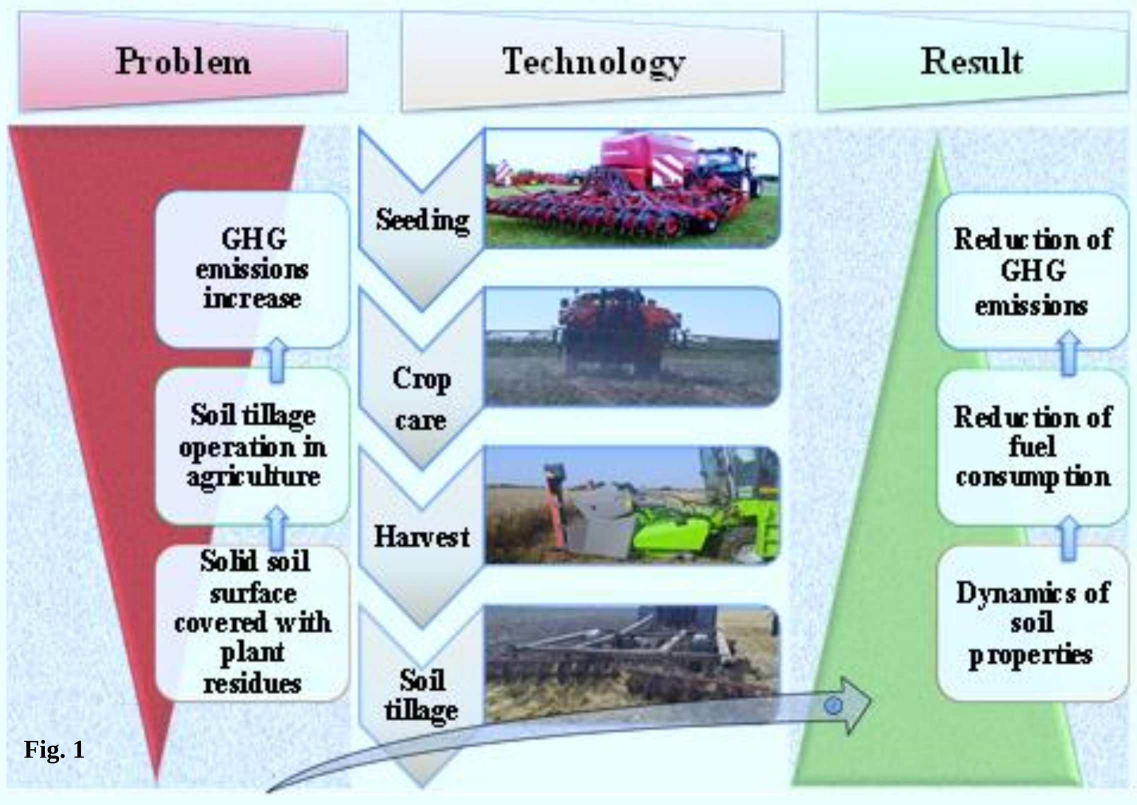


Fig. 1

There are many specialized researches on the influence of different bio-impact on the various parameters in agriculture. Different bio-impact effects various properties and the composition of soil, plant residues, harvests, and technological processes, total Global warming potential as well as the interactions between different parts of the soil, working machine tools, energy consumption and environmental pollution with harmful gases.

To summarize wide coverage investigations of various aspects of different bio-impact parameters the main objective – to identify the best-case bio-impact scenario by accounting for many criteria in several aspects. The aim - to identify bio-effect on soil characteristics, tillage and yield from environmental and economic aspects.

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 ° 534 N + 23 ° 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).

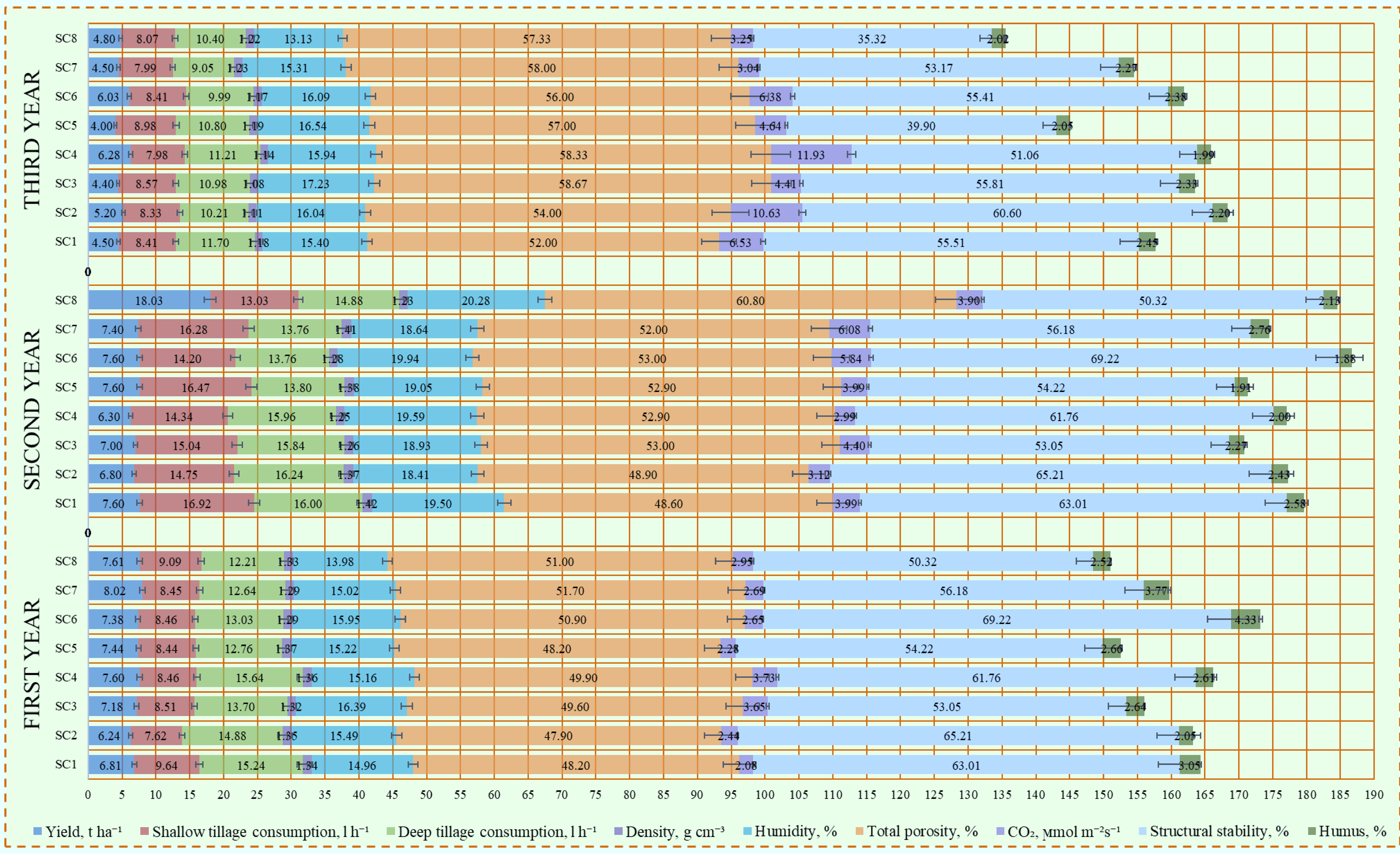
Season	Operations	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8
Autumn	Winter wheat „Ada“ (2015)/ „Famulus“ (2016))/rapeseed „Cult“ (2017) seeding	+	+	+	+	+	+	+	+
	Herbicide spraying 2.0 Lha^{-1}	+	+	+	+	+	+	+	+
Spring	Fertilization ammonium nitrate (N_{51}) 200 kg ha^{-1}	+	+	+	+	+	+	+	+
	Fungicide 0.81 L ha^{-1} and growth regulator 1.2 Lha^{-1} spraying	+	+	+	+	+	+	+	+
	Biopreparations spraying	-	+	+	+	+	+	+	+
	Water spraying	+	+	+	+	+	+	+	+
	Bio-impact 1 (BT1)	–	+	–	–	–	–	–	–
	Bio-impact 2 (BT2)			+	–	–	–	–	–
	Bio-impact 3 (BT3)	–	–	–	+	–	–	–	–
	Bio-impact 4 (BT4)	–	–	–	–	+	–	–	–
	1+2 Bio-impact	–	–	–	–	–	+	–	–
	1+3 Bio-impact	–	–	–	–	–	–	+	–
	1+4 Bio-impact	–	–	–	–	–	–	–	+
Summer	Additional fertilization ammonium nitrate (N_{68}) 140 kg ha^{-1}	+	+	+	+	+	+	+	+
	Fungicide 0.3 Lha^{-1} and growth regulator 0.3 Lha^{-1} spraying	+	+	+	+	+	+	+	+
	Additional fertilization urea (N_{46}) 10 Lha^{-1} and fungicide 1.75 Lha^{-1} spraying	+	+	+	+	+	+	+	+
	Additional fertilization ammonium nitrate (N_{68}) 80 kg ha^{-1}	+	+	+	+	+	+	+	+
	Harvest	+	+	+	+	+	+	+	+
	Disc harrowing	+	+	+	+	+	+	+	+
	Ploughing	+	+	+	+	+	+	+	+

There were carried out researches of fuel consumption parameters of soil tillage machines, yield, soil density, total porosity, humus, soil stability, soil moisture content. The evaluation used experimental research data and the SAW mathematical method to find the best-case scenario.

Assessment of the variability of energy consumption, productivity, soil factors could be compared by multicriteria analysis by classification to three different groups). It was established that multicriteria accounting can help farmers and the policy makers for sustainable agricultural production control ensuring access to safe, healthy and nutritious (Skafa et al., 2018).

Identified that different bio–effect of agricultural practices could be oriented towards a reduction in fuel consumption, followed by reductions in CO_2 emissions from machinery, dynamics of soil composition, properties and yield.

RESULTS



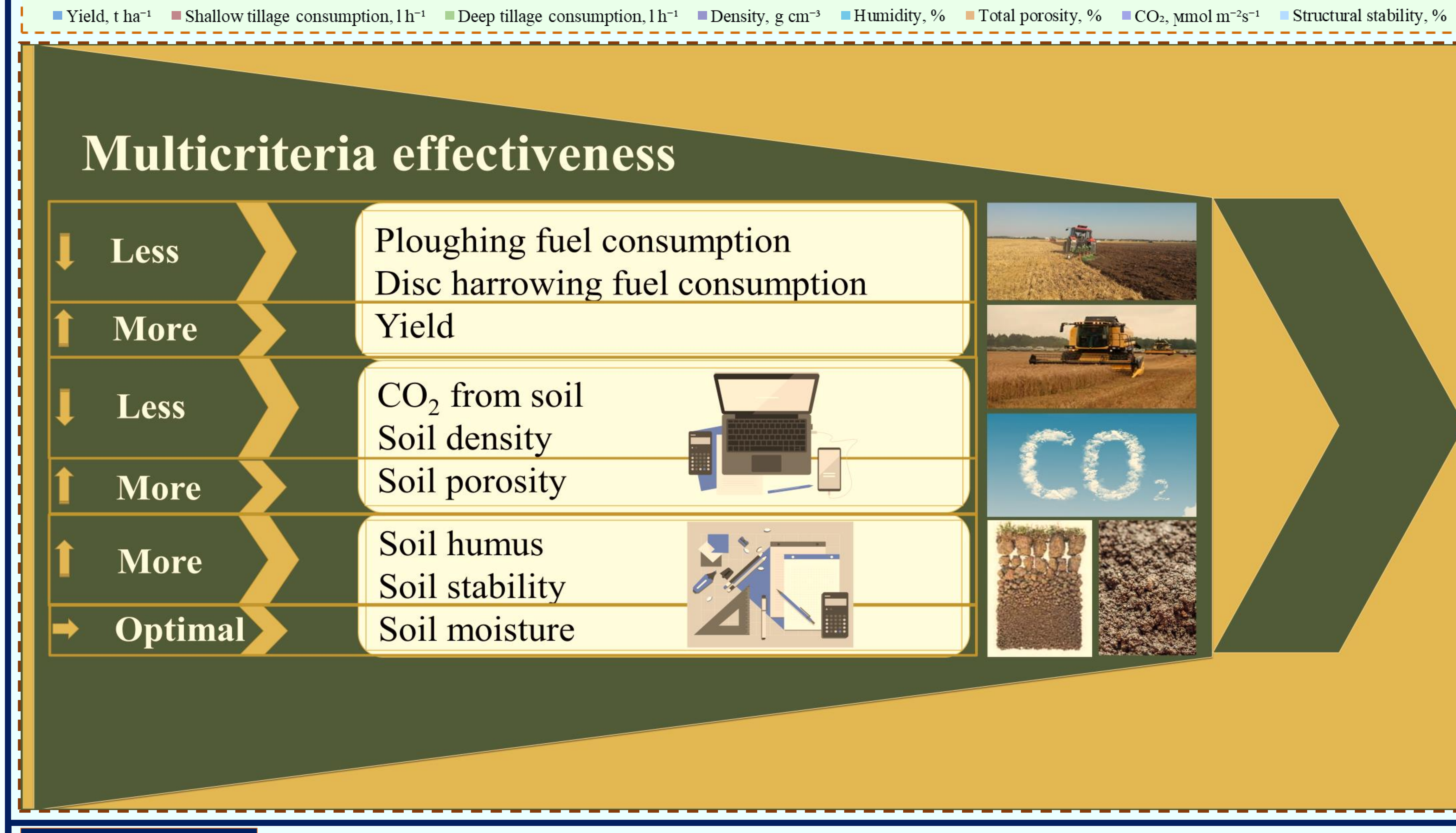
Experimental research shows that different bio-effects of agricultural practices can be oriented towards a reduction in fuel consumption, followed by reductions in CO_2 emissions from machinery and changes in soil properties, dynamics of composition, yield and other parameters. A multicriteria assessment 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 deforestation, improving soil, and increasing yields and productivity, is reasonable. The evaluation of the bio-impact effects in agriculture by accounting many criteria in several aspects was the main objective of the multicriteria assessment.

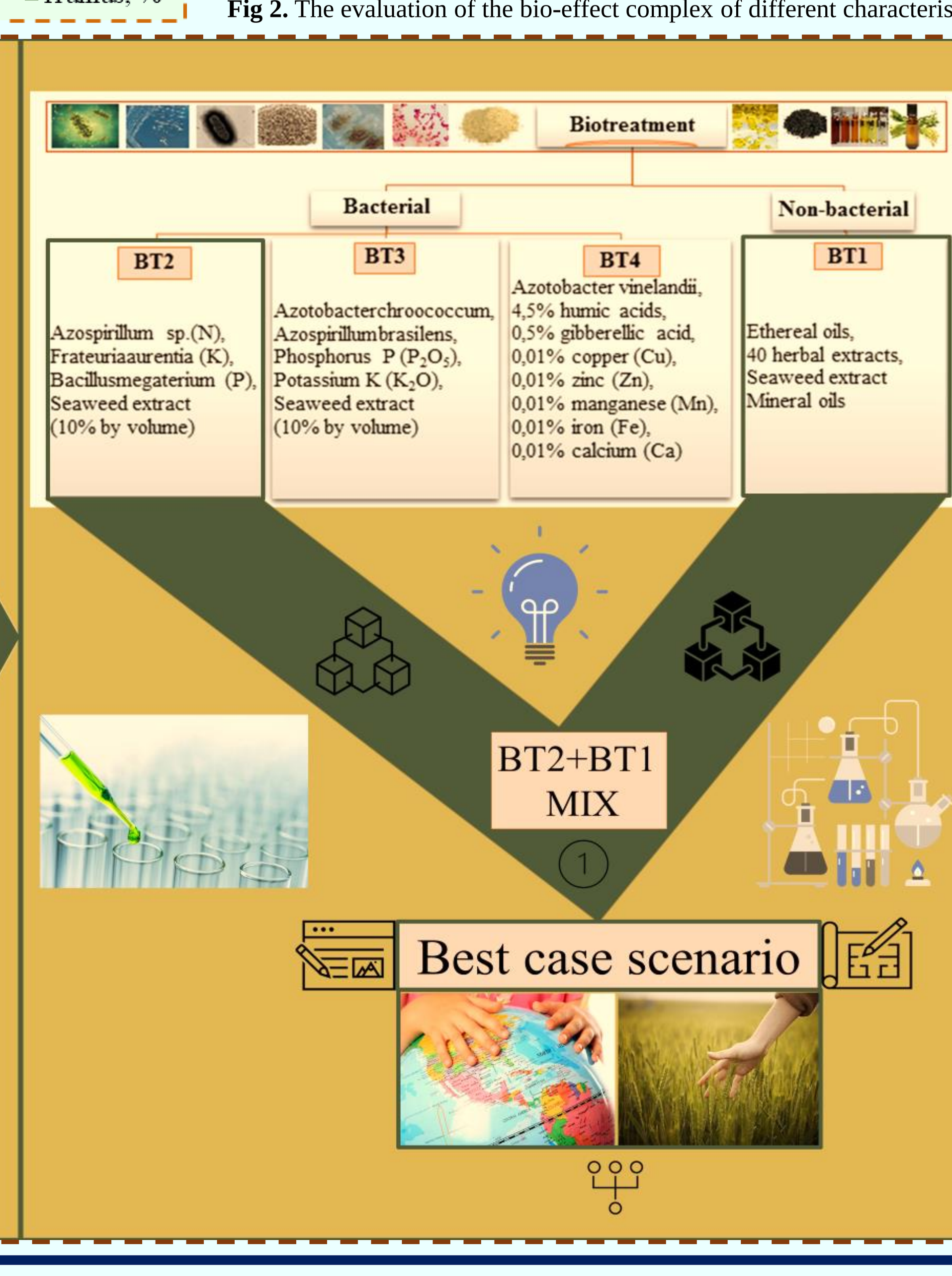
To select the best bio-impact for each criterion, the most important goal was to maximise, minimise, and optimise some of the values of the indicators by replacing the formulas. Multicriteria effectiveness was most pronounced after the first and third soil bio-impacts by solution of *Azotobacter vinelandii*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

CONCLUSIONS

- Conducted multicriteria consolidation of distinct soil bio-impact 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, CO_2 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.

Fig 2. The evaluation of the bio-effect complex of different characteristics





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