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LIFE CYCLE ASSESSMENT OF GRAIN MAIZE PRODUCTION IN DIFFERENT SOIL TILLAGE SYSTEMS

Abstract:

Crop production induces emissions of greenhouse gases (GHG) and other harmful substances to the environment. In view of the environmental protection, it is essential to find solutions for reducing the negative impacts of crop cultivation. Currently, no-tillage systems are becoming more and more popular in grain maize production due to their economic and environmental benefits. The aim of the study was to assess the environmental impact of grain maize production in different soil tillage systems. The study was conducted in 20 farms, located in the Wielkopolska voivodship (Poland), during the period 2015-2017. The cultivation of grain maize in three soil tillage systems: traditional tillage, reduced tillage and direct sowing was analyzed. Data included field characteristics, type and duration of technological operations and agricultural production inputs: seeds, fertilizers, plant protection products, fuel, engine fuel, lubricants, agricultural machinery. Assessment was performed according to the life cycle assessment (LCA) methodology. LCA was carried out from "cradle-to farm gate", i.e. from the manufacturing of means of production through to the process of crop cultivation and harvesting. Results analysis have been referenced to functional unit of 1 ha of grain maize cultivation. The following impact category indicators have been calculated: the global warming potential, the eutrophication potential, the acidification potential, the photochemical ozone creation potential and the abiotic resources depletion potential. The carbon sequestration potential associated with maize cultivation in each tillage system was estimated. The values of impact category indicators, especially in the case of global warming potential, acidification potential and eutrophication potential depended mainly on fertilization. GHG emissions from processes of soil cultivation and sowing of grain maize were largest in traditional tillage mainly due to larger fuel consumption and use of agricultural machinery in comparison to reduced tillage and direct sowing. In grain maize cultivation, carbon inputs to soil from the applied natural fertilizers and plant residues ploughed in lead to increased soil carbon sequestration and contribute to reductions in GHG emissions.
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Keywords:

grain maize, soil tillage systems, environmental impact, life cycle assessment, impact category indicators

JEL Classification: Q54, Q57