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Life cycle assessment and soil nitrogen balance of different N fertilizers for top dressing rye as energy crop for electricity generation

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Abstract-

Nitrogen fertilizers have been identified in energy crops LCAs as the main contributors to global warming, as well as to many other environmental impacts. The distinct production process and application emissions of nitrogen fertilizer types for top dressing produce different GHG savings when energy crops value chains are compared to fossil energy alternatives. In this study, three types of fertilizers (calcium ammonium nitrate, urea and ammonium sulphate) at N top dressing rates of 80 kg N/ha are used to grow rye for electricity generation under the conditions of the Continental Mediterranean climate of central-northern Spain. Complete LCAs for the whole value chain based on real data were performed in conjunction with soil nitrogen balances (SNBs) to assess the accomplishment of European Union (EU) GHG savings sustainability criteria, as well as the sustainability of fertilization practices for soil nitrogen stocks. The results obtained can provide interesting insights for policy making, since calcium ammonium nitrate, the most common fertilizer for rye crops, led to 66% GHG savings, as opposed to the 69% achieved when applying urea and 77% when ammonium sulphate was used. Nevertheless, the three fertilizers produced annual soil deficits greater than 50 kg N/ha. In order to ensure savings above 80%, as required by the EU sustainability criteria, and sustainable SNBs, additional optimization measures should be taken at key points of the value chain.

Index Terms- bioenergy; marginal lands; sustainability criteria; calcium ammonium nitrate; urea; ammonium sulphate; biomass; secale cereale; global warming; energy balance

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