Geophysical Research Abstracts
Vol. 15, EGU2013-2011, 2013
EGU General Assembly 2013

Cover crops effect on farm benefits and nitrate leaching: linking economic and environmental analysis

José Luis Gabriel (1,2), Marnik Vanclooster (1), Alberto Garrido (2), Miguel Quemada (2,3)

(1) Dpt. Environmental sciences (ELI-e), Earth and Life Institute, Université Catholique de Louvain, Croix du Sud 2 bte L7.05.02, 1348 Louvain-la-Neuve, Belgium, (jose.gabriel@uclouvain.be) , (2) Research Centre for the Management of Agricultural and Environmental Risks (CEIGRAM), Technical University of Madrid, Ciudad Universitaria, Campos de Prácticas, 28040 Madrid, Spain., (3) Dpt. of Plant Production, Escuela Técnica Superior de Ingenieros Agrónomos, Avda. Complutense s/n, Technical University of Madrid, 28040 Madrid, Spain.

Introducing cover crops interspersed with intensively fertilized crops in rotation has the potential to reduce nitrate leaching. However, despite the evident environmental services provided and the range of agronomic benefits documented in the literature, farmers' adoption of the technique is still limited because growing CC could lead to extra costs for the farm in three different forms: direct, indirect, and opportunity costs. Environmental studies are complex, and evaluating the indicators that are representative of the environmental impact of an agricultural system is a complicated task that is conducted by specialized groups and methodologies. Multidisciplinary studies may help to develop reliable approaches that would contribute to choosing the best agricultural strategies based on linking economic and environmental benefits.
This study evaluates barley (Hordeum vulgare L., cv. Vanessa), vetch (Vicia villosa L., cv. Vereda) and rapeseed (Brassica napus L., cv. Licapo) as cover crops between maize, leaving the residue in the ground or selling it for animal feeding, and compares the economic and environmental results with respect to a typical maize–fallow rotation. Nitrate leaching for different weather conditions was calculated using the mechanistic-deterministic WAVE model, using the Richards equation parameterised with a conceptual model for the soil hydraulic properties for describing the water flow in the vadose zone, combined with field observed data. The economic impact was evaluated through stochastic (Monte-Carlo) simulation models of farms' profits using probability distribution functions of maize yield and cover crop biomass developed fitted with data collected from various field trials (during more than 5 years) and probability distribution functions of maize and different cover crop forage prices fitted from statistical sources. Stochastic dominance relationships are obtained to rank the most profitable strategies from a farm financial perspective. A two-criterion comparison scheme is proposed to rank alternative strategies based on farm profit and nitrate leaching levels, taking the baseline scenario as the maize–fallow rotation. The results show that cover crops reduced nitrate leaching respect to fallow almost every year and, when cover crop biomass is sold as forage instead of keeping it in the soil, greater profit were achieved than in the baseline scenario. While the fertilizer could be lower if cover crop is sold than if it is kept in the soil, the revenue obtained from the sale of the cover crops can compensate improvement of the soil properties. The results show that cover crops would perhaps provide a double dividend of greater profit and reduced nitrate leaching in intensive irrigated cropping systems in Mediterranean regions. But, if agro-environmental services provided by leaving the barley residue in the field were to be promoted, farmer subsidies would be required to promote cover cropping.

Acknowledgements: Financial support by Spain CICYT (ref. AGL 2011-24732), Comunidad de Madrid (project AGRISOST, S2009/AGR-1630), Belgium FSR 2012 (ref. SPER/DST/340-1120525) and Marie Curie actions.