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THE EFFECTS OF IRRIGATION REGIME AND NITROGEN RATES ON RAPESEED YIELD FOR BIOFUELS OBTAINING

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Abstract

The paper aims to establish the role of interaction of irrigation regime and nitrogen rates on NO_X emissions of rapeseed crop. Three N fertilizer rates 0 (N_0), 150 (N_{150}) and 270 (N_{270}) kg/ha, two irrigation regime (non-irrigated (I_0) and irrigated at 50% from IUA (I_1)) and three cultivars (one variety and two hybrids) were established as feedstock treatments to obtain rapeseed. The experiments were conducted in a randomized complete block design arrangement in split factorial with three replications. Correlations between irrigation regime, nitrogen rates and cultivars regarding the nitrogen oxides emissions were established. The recorded results show that NO_X emissions of the crop are for the irrigated variants lower than those of nonirrigated variants.

MATERIAL and METHODS

A three factorial experiment was conducted in 2019 at Mihai Viteazu (46^0 35` N and 23$^0$ 47` E, elevation 345 – 493 m above sea level) in Cluj county, Romania. The summary of the experimental factors is presented in Table 1.

Analyzed factors	Graduations
Factor A *Irrigation regime*	I_0 -non-irrigated
	I_1 -irrigated at 50% from IUA
Factor B *Fertilization*	N_0 -non-fertilized
	N_{150} -fertilized 150 N kg/ha + 75 kg /ha P + 20 kg S
	N_{270} -fertilized 270 N kg/ha + 75 kg /ha P + 20 kg S
Factor C *Cultivar*	Dexter
	NK Caravel
	NK Tehnic

Table 1. *Experimental factors*

A rectangular shape was chosen for the test parcels (2x5 m, 10 m^2) with isolation spaces (3 m) necessary to eliminate the occurrence of possible influences between the neighboring crops. The boundaries of the land used for the proposed research were marked with a 5 m width, in order to prevent any possible influence between experimental parcels (nutrient transport and humidity influence) which might have led to interpretation errors. The comparative crops were developed in a polifactorial system, completely randomized, with subdivided parcels, as *factor A* is the water regime (two graduations), *factor B* is fertilization (four graduations) and *factor C* – cultivar (three graduations), the biological material chosen. Three repetitions were provided for each comparative crop. Irrigation was performed by furrows.

Results

Table 2 synthesizes GHG emissions determined for all crop variations realized at Mihai Viteazu – Cluj county, in 2019. GHG emissions are expressed in carbon dioxide equivalent per liter of biodiesel, CO2 eq/l biodiesel.
Analysis of the results show the influence of experimental factors A*, irrigation regime* and B, *fertilization* on crop yields in 2019, GHG emissions and NOx emissions from soil. Analysis of the results allows recommending the rape culture variant considered optimal concerning the production - GHG emissions report.

Crop variants	Average yield (t/ha)	GHG emissions (kg CO2 eq/l	NOx emission from soils (kg CO2 eq/l)
a_1 x b_1 / nonirrigated x nonfertilized	16,040	0,014	0,001
a_1 x b_3 / nonirrigated x fertilized 150N	21,014	0,118	0,105
a_1 x b_4 / nonirrigated x fertilized 270N	21,977	0,194	0,180
a_2 x b_1 / irrigated x nonfertilized	18,927	0,012	0,001
a_2 x b_3 / irrigated x fertilized 150N	26,947	0,092	0,082
a_2 x b_4 / irrigated x fertilized 270N	27,430	0,156	0,145

Table 2*. GHG emissions, calculated for the rapeseeds crop variants realized at Mihai Viteazu – Cluj county, 2019*

- The NOx emissions from soils represent on an average 80% of the total quantity of GHG emissions.
- The results obtained highlight the need of crop fertilization, by achieving larger yields per hectare for the fertilized variant, but at the same time, associated to the increase of GHG emissions. Analyzing the NOX emissions ratio as compared to the total GHG emissions quantity one may notice that fertilization intensifies the NOX production as a result of the nitrification and denitrification processes. The avoidance of the nitrogen excess can be performed by improving the nitrogen ingestion efficiency through crops, which leads to a lower fertilizers consumption on the agricultural fields. The nitrogen input should meet the crop demands and the most adequate techniques need to be adopted. The results recorded also show that, when applying irrigation, the GHG and NOX emissions decrease.
- The results obtained for the rapeseed crop cultivars highlight the need for nitrogen fertilization in order to obtain increased yields and to irrigate crops so that GHG and NOx emissions are reduced.
- Agriculture can also reduce GHG emissions by providing biofuels, fuels derived from biomass sources. Application of best management practices in agriculture and use of biofuels for GHG mitigation can have substantial co-benefits.

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