Comparing grazing intensities in crop-livestock systems with STICS

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Summary

Integrated crop-livestock systems (ICLS) are increasingly considered as key solutions to maintain high food production while minimizing agricultural impacts on the environment. But there is still little knowledge on the impact of adding a trophic level (i.e. herbivore animals) in cropping systems on their stability and resistance, as well as on soil fertility.

In that study, we established a methodology to simulate with the soil-crop model STICS the grazing process. We based on a 18-year ICLS field experiment in South Brazil (Rio Grande do Sul) consisting in soybean-pastures grazed by cattle beef, with contrasting grazing intensities (10, 20, 30 and 40cm grazing and one ungrazed treatment), to calibrate and validate the methodology. In that field experiment, each grazed paddock received three animals that remained throughout the whole experiment, plus a variable number of put-and-take animals that were regularly added or removed to maintain the targeted sward heights (Kunrath et al., 2020).

Based on Graux et al. (2020), we simulated frequent sward cuts (and associated cattle dung/urine inputs) to model the rate of return of the animal on a same plant and maintain the sward height as processed in the field experiment. The different plant parameters, for the soybean but also for the pasture composed of ryegrass and black oat, were adjusted from standard STICS parameters. Based on Da Souza et al. (2019), that measured steers individual DMI and fecal production, we also slightly adjusted the parameters of Graux et al. (2020) for computing cattle dung and urine, also considering that in our case, animals are steers and not milking cows. We also determined a ratio of conversion of forage into live weight gain, dependent on the grazing intensity.

Next we extrapolated the simulations to future climatic conditions at the same place (period 2040-2060, RCP8.5) to investigate the stability and resistance of these systems when facing climate change. They were mathematically computed from the characterization of climatic events as moderate or extreme, based on the SPEI drought index (Vicente-Serrano et al., 2010; Isbell et al., 2015).

It appeared that the ICLS systems have a greater total production (soybean, sward and meat) than the ungrazed treatment, with meat production increasing with grazing intensity. Soybean yields would globally decline with climate change but sward biomass would increase. Moderate grazing intensities seem ideal to adapt to and mitigate climate change, with greater resistance capacities and carbon sequestration.

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