Predicting grass growth: The MoSt GG model

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Introduction

PastureBase Ireland (PBI - Hanrahan et al., 2017) is a grassland management tool for farmers. PBI helps farmers to manage the grass on their farm, identify grass supply surpluses or deficits and to take appropriate action. However, currently within PBI farmer can only make decisions based on historical information. The incorporation of a predictive model within PBI such as the MoSt GG (Ruelle et al., 2018) would allow farmer to get information on the future growth of their farm. And help to facilitate anticipation and improve decision making.

Materials and Methods

The MoSt GG model (Ruelle et al., 2018) is a dynamic model developed in C++ describing the grass growth and the nitrogen (N) and water fluxes of a paddock. The model is run with a daily time step simulating soil N mineralisation, immobilisation and water balance, grass growth, N uptake and grass N content. The model is driven by a daily potential growth depending on the radiation and the total green biomass. To calculate the actual daily growth, this potential growth is then multiplied by parameters depending on environmental conditions (temperature, water in the soil and radiation) and a parameter depending on the availability of the mineral N in the soil compared to the N demand associated with the potential grass growth. Animal depositions of N from dung and urine are also separately represented by the model. The main inputs of the model are the soil type (% sand and clay, organic matter and soil mineral N content), the weather (temperature, rainfall and solar radiation) and paddock management (fertilisation, grazing and cutting). The MoSt GG model was evaluated using experimental data for 2013-2018 from three Teagasc experimental farms - Ballyhaise, Clonakilty and Curtins in Ireland.

Results and Discussion

Overall the model showed a similar accuracy across the three farms. The accuracy at the paddock level with RMSE of between 27 (Curtins 2018) to 31.7 kg DM/ha day (Ballyhaise 2014) is quite poor, however the accuracy at the farm level of between 11.5 (Ballyhaise 2015) to 17.9 kg DM/ha/day (Clonakilty 2016) is quite promising. The Figure 1 presents the simulated and recorded growth during two contrasting years.

Since February 2019 the model is being used to predict grass growth on 40 farms across Ireland. The farms are representative of the soil type and geographic variability of Ireland. Historical and forecast weather data is provided for each individual farm by Met Éireann, the Irish Meteorological Service. Information about N fertiliser and grazing and cutting events are entered weekly by the farmer in to PBI. The weekly grass growth is communicated to farmers involved in the pilot study in the form of a map sent to the farmers on a Tuesdays. The feedback from the farm managers is very positive, and the farmers consider the predictions are very useful aids to decision making and help to be more confident.

Conclusion

The MoSt GG model is a mechanistic model developed for both research and farmer use. The initial evaluation indicates that the model is capable of adapting to differences in farm and in weather conditions. The pilot study currently on-going will provide a true indication of the MoSt GG model's ability to provide useful grass growth prediction across soil types, regions and management conditions. If the pilot study is successful, and the accuracy of the model is sufficient across the different farms, the model will be integrated into PBI.

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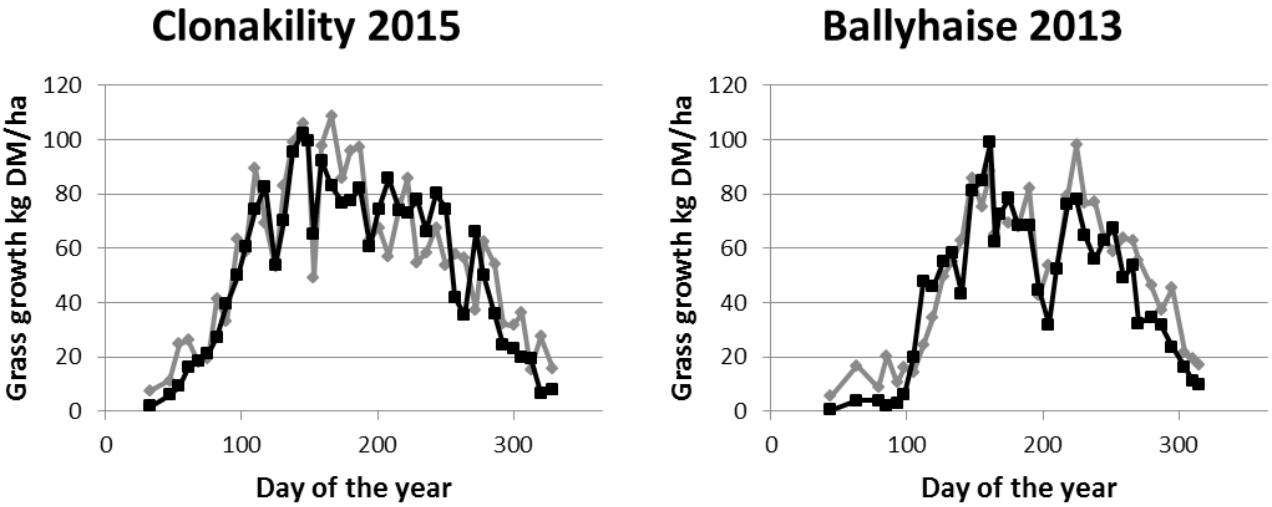

Left Clonakility 2015, RMSE 13.8 kg DM/ha, CCC 0.89 Right Ballyhaise 2013, RMSE 12.0 kg DM/ha, CCC 0.90
Figure 1: Comparison between the growths recorded in PBI (grey) and predicted by the MoSt model (black) for two contracting years in two contrasting farms.

References:

1. Hanrahan L., Geoghegan A., O'Donovan M., Griffith V., Ruelle E., Wallace M., Shalloo L., 2017, PastureBase Ireland: A grassland decision support system and national database. Comput. Electron. Agric., 136, 193-201, https://doi.org/10.1016/j.compag.2017.01.029
2. Ruelle E., D. Hennessy L. Delaby ,2018, Development of the Moorepark St Gilles grass growth model (MoSt GG model): a predictive model for grass growth for pasture based systems. Eur. J. Agro., 99: 80-91, https://doi.org/10.1016/j.eja.2018.06.010