Invitation à la soutenance publique de thèse

Pour l'obtention du grade de Docteur en Sciences agronomiques et ingénierie biologique

Monsieur Benoît CASSART
Master bioingénieur : gestion des forêts et des espaces naturels

Effect of community functional trait composition on soil organic carbon dynamics between Gilbertiodendron dewevrei monodominant forests and Scorodophloeus zenkeri mixed forests in the Central Congo basin

In the Congo basin, Gilbertiodendron dewevrei frequently occurs as large patches of monodominant forests (MOF) located next to higher diverse Scorodophloeus zenkeri forests (mixed forests, MIF). Although a series of functional traits, including leaf litter characteristics, have been shown to control monodominance in those systems, their role in regulating soil organic C (SOC) dynamics remains largely unknown. In the present work, we examined how roots and foliar litter traits affected soil C dynamics (stocks and fluxes) under MIF and MOF located on highly weathered sandy soils in the Yoko reserve (DRC).

In addition to estimates of aboveground and soil (forest floor plus mineral soil down to 220 cm depth) C stocks, we measured soil respiration with and without forest floor contribution, aboveground foliar litterfall and fine roots production in topsoil (forest floor plus 0-10 cm layer) during a one-year period. Early leaf litter decomposition (≤ 6 months) of the 8 most abundant tree species and all their two-way combinations was assessed through a field incubation experiment.

While the combined SOC (forest floor plus mineral soil down to 220 cm) and aboveground C stocks were similar in both forests, SOC stocks were 55 % higher under MOF compared to MIF. Similar organic matter inputs were observed under both forest types but above- and belowground litter quality in MOF strongly differed by a set of traits related to organic matter recalcitrance; in particular leaf litter of G. dewevrei was located at the “conservative” end of the leaf economic spectrum (LES). Through our incubation experiment, we showed that the position of the litter along this LES strongly controlled the variation in leaf litter decay rates during the first 3 months of incubation suggesting contrasted decay rates between MIF and MOF. On an annual basis, soil respiration was 10% higher under MOF compared to MIF and forest floor removal significantly reduced soil respiration only in MIF, by ca. 18%. Based on a process-based conceptual model parameterized by environmental variables, MOF has been shown to favour the heterotrophic soil respiration through its twofold SOC accumulation.

By decreasing the decay rate of fresh organic matter and of soil organic matter, the low-quality litter of G. dewevrei, together with some other traits, increased C accumulation in soil under MOF compared to MIF leading to contrasted soil CO2 efflux partitioning. However, the dominance of G. dewevrei did not appear to limit the aboveground C storage nor the net primary productivity (as inferred from similar above- and belowground litter production). Our results highlight that reliable assessment of the global leaf and/or root economics spectrum should prove valuable in modelling SOC dynamics in tropical forests.

Membres du jury :
Prof. Quentin Ponette (UCL), promoteur
Prof. Bruno Delvaux (UCL), président
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Prof. Charles de Canniere (ULB)
Dr. Nicolas Picard (FAO, Roma, Italie)
Dr. Hans Beeckman (MRAC, Belgique)
Prof. Pascal Boeckx (UGent)

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Salle de Séminaire ISV
Bâtiment Camoy
Place Croix du Sud, 4-5
1348 Louvain-la-Neuve