Assessment of litter decomposition in temperate deciduous forest: case study in Fruška gora, Serbia

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INTRODUCTION. The litter decomposition is one of the largest fluxes in the global terrestrial carbon cycle, thus diverse extensive experiments have been focusing on this fundamental soil process. Our study has been conducted as a part of the large-scale decomposition experiment within the global collaborative network ***TeaComposition initiative***. The aim of this initiative was to estimate short- to long-term plant litter decomposition rates by using standard protocols and substrates—commercially available Green tea and Rooibos tea with different decomposition rates—for comparison of the litter mass loss at numerous sites across various ecosystems worldwide. The objective of our study was to test the effects of both litter type and land-use on litter decomposition in three, 12, 24 and 36 months of incubation (year 2016 to 2019), by comparing the percentages of the tea mass lost.

METHOD & DESIGN. The TeaComposition method (modified Tea bag method by Keuskamp et al. 2013) involves measuring a tea bag before and after incubation in the field, and using mass loss as a measure of the organic material decomposed. The three localities chosen for our experiment corresponded to the three levels of protection regime established for the National park Fruška gora, with different management treatments. The 1st sub-site is within the highest level of protection—the least degraded and non-managed forest; 2nd and 3rd sub-sites are under 2nd and 3rd level of protection, both characterized by controlled wood exploitation. The guidelines of the standardized protocol of the ***TeaComposition initiative*** (Djukic et al. 2018) were followed throughout. Two homogenous plots were selected at each of the three sub-sites; two replicates of the two tea types were buried in the topsoil layer in each plot, resulting in four bags of each tea type per sub-site and sampling time (Figure 1).

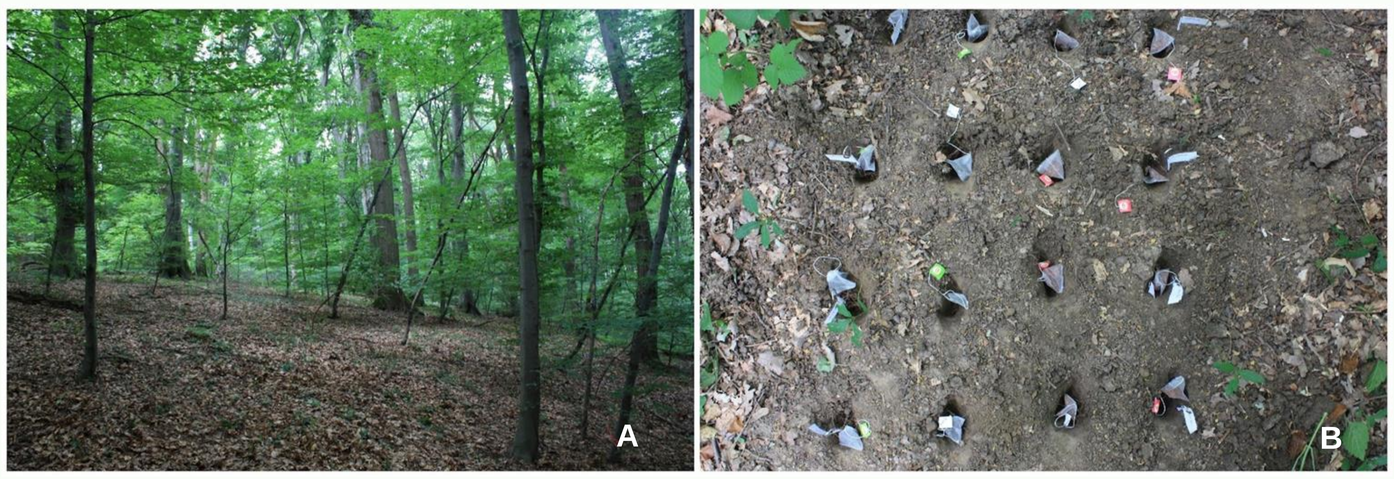

Figure 1. The 1st sub-site of the site Fruška gora (A); tea bags installation plot within the 2nd sub-site (B).

Table 1. Tea mass loss in four periods of incubation

Tea type	Plot / treatment	Initial weight [g]*	Weight after 3 months [g]**	Mass loss in 3 months [%]	Weight after 12 months [g]**	Mass loss in 12 months [%]	Weight after 24 months [g]**	Mass loss in 24 months [%]	Weight after 36 months [g]**	Mass loss in 36 months [%]
Green	I / no intervention	1.802	0.477	**74**	0.481	**73**	0.391	**78**	0.467	**74**
Green	II / selective cutting	1.782	0.480	**73**	0.452	**75**	0.754	**58**	0.877	**50**
Green	III / selective cutting	1.816	0.531	**70**	0.353	**81**	0.374	**79**	0.441	**75**
Rooibos	I / no intervention	1.927	1.268	**34**	1.016	**47**	0.912	**53**	1.086	**44**
Rooibos	II / selective cutting	1.926	1.292	**32**	1.040	**46**	1.109	**43**	1.264	**34**
Rooibos	III / selective cutting	1.940	1.520	**21**	1.294	**33**	0.968	**50**	1.296	**34**

*Average weight (without bag, string and tag) of all tea bags per plot before incubation
**Average weight (without bag, string and tag) of tea bags per plot retrieved after 3/12/24/36 months incubation

RESULTS. The values of the tea mass lost during all four incubation periods were higher for the Green tea than for the Rooibos tea (Table 1). This pattern was expected because of the faster decomposition rate of Green tea due to higher content of non-lignified cellulose and of water-soluble compounds (Keuskamp et al. 2013). Furthermore, the difference of the two tea types' mass loss was the highest in three-months incubation. Our study has also shown no clear pattern regarding the values variation of the tea mass loss among plots of three different sub-sites. However, the highest level of variation was found for the Green tea in the longer incubation periods (24 and 36 months).

CONCLUSIONS. Our results are in accordance with previous research (e.g. Djukic et al. 2018; Kwon et al. 2021) showing that, in the early stage of litter decomposition, the litter quality had the strongest influence on mass loss, whereas there was no significant effect of land-use or management practices. The microbial decomposition is carried out by many groups of microorganisms and is not limited by nutrients during the growing season. Still, differences in the litter mass loss among the land-use types increase in the later phases—as decomposition progresses—because of the decomposer groups being more selected, i.e., fewer microbes possess the degradation enzymes for the remaining organic compounds. This pattern is more clear in Green tea, because Rooibos tea has much slower litter decomposition rate, due to high lignin content.
These conclusions suggest that potential shifts in the relative abundance of vegetation types in the future caused by climatic changes could have large effects on global carbon budgets alone due to the differences in litter quality and consequently decomposition rates.

References
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