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BOOK OF ABSTRACTS

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Productivity and Belowground Biomass Input of Maize Growing with Living Mulches Compared to Common Production Systems in Germany

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Maize (*Zea mays L.*) based production systems increasingly integrate cover crops to improve nitrogen retention and soil carbon without yield penalty (Salisu et al., 2025). In Germany, maize production systems typically include maize grown without cover crops (fallow) or with non-living mulch (NLM), where cover crops are terminated before maize sowing. Living mulch (LM), where cover crops grow alongside and compete with maize, has gained interest recently. While NLM generally sustains main crop yield, LM can introduce competition that affects biomass production and nutrient uptake (Bhaskar et al., 2021). However, the link between production systems, main crop yield, and belowground biomass, an important driver of long-term soil carbon and nutrient cycling (Yang et al., 2023), remains poorly understood.

We evaluated whole-crop maize productivity and belowground biomass in production systems with and without cover crops across 3 sites- Reinshof (Phaeozem), Hohenschulen (Luvisol), and Karkendamm (Podsol) in Germany, over 2 growing seasons (2024 - 2025). At each site, a randomized complete block design with 4 replicates was used to compare 8 cover crop treatments differing in species composition and winter hardiness with a fallow control. For brevity, treatments were grouped into 3 production systems: LM, NLM, and control. Cover crops included Sorghum, White clover, Persian clover, Oilseed radish, Winter rapeseed, and Red fescue. Maize aboveground biomass was assessed at BBCH 85 at all sites in 2025, and only at Reinshof in 2024. Belowground biomass was assessed at BBCH 65 in 2024 at Reinshof only, from 0 - 30 and 30 - 60 cm soil depths. Samples were taken within maize row (MR), near maize row (NMR), and between maize rows (BMR), and integrated to estimate total belowground biomass. Data were analyzed using linear mixed-effects models with sampling plot nested in block as a random effect.

At Reinshof, maize dry matter yield was significantly affected by the production system x year interaction ($p < 0.001$). LM consistently reduced biomass yield, reaching 10.1 and 17.1 t ha^{-1} in 2024 and 2025, compared with 23.7 and 22.1 t ha^{-1} in the control, and 22.4 and 23.1 t ha^{-1} in the NLM. In 2025, the production system x site interaction was significant ($p = 0.041$), although the main effect of site was not. Across all sites, LM resulted in the lowest yields (10.3 - 17.1 t

ha^{-1}), while control and NLM were generally higher and comparable (13.9 - 23.1 t ha^{-1}), although the magnitude of yield differences varied among sites. At Reinshof in 2024, belowground biomass at 0 - 30 cm differed among production systems and positions. LM significantly reduced belowground biomass at MR (2.08 ± 0.20 t ha^{-1}) compared with control (3.47 ± 0.44 t ha^{-1}) and NLM (4.52 ± 0.24 t ha^{-1}), but increased belowground biomass at NMR (0.60 ± 0.11 t ha^{-1}) and BMR (0.50 ± 0.10 t ha^{-1}), as a result of the companion crops or lateral root growth. No significant differences were observed at 30 - 60 cm, showing competition was limited to the upper soil layer. Total belowground biomass was highest under NLM (≈5.03 t ha^{-1}), followed by control (≈4.03 t ha^{-1}) and LM (≈3.50 t ha^{-1}), while LM had the highest root-to-shoot ratio (0.35) compared with NLM (0.22) and control (0.17), indicating greater belowground allocation. Overall, NLM sustained maize productivity and belowground biomass similar to control, while LM reduced yield and altered root distribution due to competitive interactions.