S04-O5. Neighbour-induced alterations in root exudate composition of cover crops

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Over the past decade, extensive research at Agroscope has aimed to understand the mechanisms by which cover crops (CC) suppress weeds in both field and controlled conditions, attempting to separate the factors involved in weed suppression. A split-root setup was developed to study the effect of CC root exudates.

Field trials demonstrated that shading alone was not the primary mechanism for pigweed (Amaranthus retroflexus) growth suppression, as biomass remained similar under different light conditions. Additionally, under controlled conditions, buckwheat (Fagopyrum esculentum), black oat (Avena strigosa), and forage radish (Raphanus sativus) significantly suppressed pigweed growth through direct root interactions. These findings suggest that root exudates may mediate CC–weed interactions.

We investigated how buckwheat and black oat modify their root exudates and influence weed root architecture when interacting with intra- and interspecific neighbors like pigweed and blackgrass (Alopecurus myosuroides). When applied to weeds, root exudates from buckwheat and black oat led to a complex pattern of changes in weed root morphology. We characterized metabolomic changes in CC root exudates and assessed their effects on neighboring plants and weeds. Among 2,843 compounds, our results showed that plant neighbors induced significant shifts in root exudate composition, with 92 and 89 more accumulated compounds in black oat exudates in the presence of pigweed and blackgrass, respectively, compared to the black oat control. The responses varied depending on the identity of the neighbor. However, identifying compounds of interest proved challenging due to limited data on CC root exudates in existing databases. Molecular network analysis identified clusters of significant differentially accumulated metabolites, including hexose sulfate derivatives, aromatic amino acids, and organic acids, which were enriched in black oat exudates when grown with another neighbor. Transcriptome analysis revealed that the phenylpropanoid pathway was consistently enriched in black oat leaves, while flavonoid biosynthesis and circadian rhythm pathways were activated in roots in response to neighbors. These pathways are known to be involved in plant defense and allelopathic interactions.

These results provide new insights into the role of root exudates in plant–plant interactions and demonstrate the potential of CC to suppress weeds through belowground chemical signaling.

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