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Effect of root hairs and benzoxazinoids on maize microbiome and its enzymatic activity in the rhizosphere

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Root morphology and the composition of root exudates shape the spatial organization and various processes in the rhizosphere. For instance, root hairs are essential for plant nutrition, while secondary plant metabolites (i.e. benzoxazinoids) ensure plant defence from herbivore and fungal infection. Nevertheless, it is still unknown to which extent root hairs and benzoxazinoids may change the microbiome and enzymatic activities, as well as formation of rhizosphere hot- and coldspots.

To study the effect of root hairs and benzoxasinoids on the rhizosphere microbiome structure and its enzymatic activities we compared mutants with defective root hairs *rth3* or with reduced benzoxazinoids *bx1* with the corresponding wild-type (WT) maize.

Root hairs increased acid phosphatase activity by 80 % promoting mineralization of organic phosphorus sources to available forms in the hotspots. In the coldspots, broken root hairs in WT facilitated the intensive microbial hotspots with up to two times higher β-glucosidase and chitinase activities, compared to *rth3*.

The presence of benzoxazinoids in root exudates strongly supported plant defence against pathogenic fungi (i.e., genus *Fusarium* and *Gibberella*) while the total microbial biomass remained unaffected. In response to the presence of pathogenic fungi, *bx1* exuded 70 % more chitinase for defence purpose to partly compensate for benzoxazinoids deficiency, which was however, less efficient against pathogens than the presence of benzoxazinoids.

Overall, we conclude that: i) root hairs facilitate better plant nutrition at the shortage of available nutrients (i.e., coldspots), while; ii) the presence of benzoxazinoids in exudates protect plant from pathogenic microorganisms. This two root traits are promising for plant breeding of genotypes

suitable for sustainable agriculture and organic farming.