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Differential composition of epicuticular waxes in wild and domesticated barley affects leaf physiology and plant-herbivore interactions

Barley (*Hordeum vulgare*) is an important agricultural cereal crop, however due to extensive breeding, domesticated cultivars are characterized with altered physiology and partial/complete loss of stress tolerance. Herein, we investigated whether differential compositions of epicuticular waxes (EW) in wild and domesticated barely affect leaf physiology and interactions with herbivores. Metabolite profiling of the two cultivars for their EW compositions via Gas Chromatography-Mass Spectrometry (GC-MS) revealed that wild barley leaves accumulate ~33% more waxes compared to leaves of the domesticated cultivar, as also inferred by Scanning Electron Microscopy (SEM) of leaf surfaces. It seems that the higher wax loads detected in wild barley are attributed to higher levels of primary alcohols, the predominant wax constituents of barely leaves. EW are known to minimize water loss through transpiration, yet measurements suggested that wild barley transpire at higher rates, likely as its leaves are ~20% more densely covered by stomata. Photosynthetic evaluations performed by Li-COR indicated that domesticated barley exhibit higher rates of carbon assimilation and stomatal conductance in response to increased light intensities. Finally, barley EW were previously suggested as important determinants of plant-herbivore interactions, and thus, we fed tobacco cutworm (*Spodoptera litura*) larva with leaves belonging to the two cultivars. These demonstrated that ~42% more surface areas of domesticated leaves were eaten compared to wild leaves, suggesting that higher EW loads and density apparently interfere with the feeding process of larva. Altogether, our findings provide insight to the importance of EW in leaf physiology and interactions with the environment.

Recent Publications

1. Cohen H, Szymanski J, Aharoni A (2017) Assimilation of 'omics' strategies to study the cuticle layer and suberin lamellae in plants. *Journal of Experimental Botany* 68:5389-5400.
2. Cohen H, Dong Y, Szymanski J, Lashbrooke J, Meir S, Almekias-Siegl E, Zeisler-Diehl VV, Schreiber L, Aharoni A (2019) A multilevel study of melon fruit reticulation provides insight to skin ligno-suberization hallmarks. *Plant Physiology* 179:1486-1501.

3. Cohen H, Fedyuk V, Wang C, Wu S, Aharoni A (2020) SUBERMAN regulates developmental suberization of the Arabidopsis root endodermis. *Plant Journal* 102:431-447.
4. Wang C, Wang H, Li P, Li H, Xu C, Cohen H, Aharoni A, Wu S (2020) Developmental programs interplay with ABA to coordinate root suberization in Arabidopsis. *Plant Journal* 104:241-251.
5. Dong Y, Sonawane P, Cohen H, Polturak G, Feldberg L, Avivi S, Rogachev I, Aharoni A (2020) High-resolution, spatial metabolite mapping enhances the current plant gene and pathway discovery toolbox. *New Phytologist* 228:1986-2002.
6. Arya GC, Sarkar S, Manasherova E, Aharoni A, Cohen H (2021) The plant cuticle: an ancient barrier set against long-standing rivals. *Frontiers in Plant Science* 12:e663165.
7. Gupta S, Vishwakarma A, Kenea H, Galsurker O, Cohen H, Aharoni A, Arazi T (2021) CRISPR/Cas9 mutants of tomato MIR164 genes uncover their functional specialization in development. *Plant Physiology* 187:1636-1652.

Biography

Hagai Cohen obtained his PhD. in Plant Molecular Biology in the Faculty of Biology at the Technion – Israel Institute of Technology, Israel, investigating the regulatory metabolic pathways involved in amino acid biosynthesis in plant seeds. It is then where he started to focus on metabolism in plants. During his Postdoctoral Fellowship at the Weizmann Institute of Science, Israel, he investigated the metabolic pathways leading to the formation of lipophilic barriers in plants such as epicuticular waxes, cutin, suberin and lignin. In early 2020, he opened his independent laboratory as a Principal Investigator in the Department of Vegetable and Field Crops, the Institute of Plant science at the Agricultural Research Organization (ARO), Volcani Center, Israel. His group is interested in elucidating various aspects of interactions between plant surfaces and pathogens, with a particular focus on metabolic networks operating on the course of pathogenic attack and invasion.

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