Study reveals bioactive power of a natural spearmint compound against weeds

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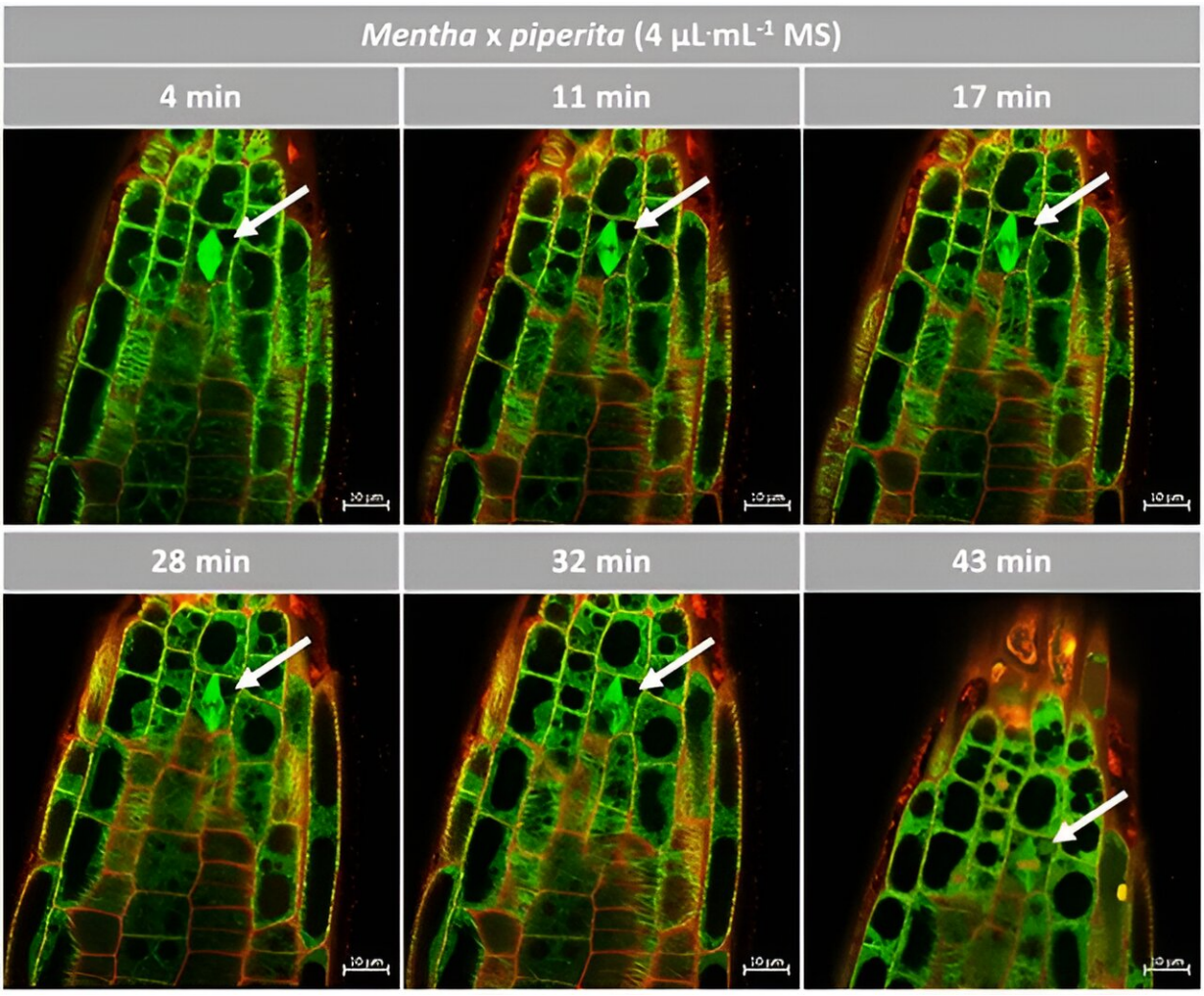

Response of microtubules to the essential oil of M. x piperita in Arabidopsis. Credit: *Horticulture Research*

A recent study reveals the natural compound (-)-carvone in spearmint as a potent and sustainable alternative to chemical herbicides. This research demonstrates how (-)-carvone targets and degrades microtubules in weeds, inducing cell death and inhibiting growth without harming the environment. The findings suggest a future where allelopathic plants offer eco-friendly solutions to weed management, supporting biodiversity and reducing the reliance on harmful chemicals in agriculture.

The quest for sustainable agricultural practices has led researchers to explore allelopathy, where plants release natural compounds to inhibit the growth of neighboring species. Traditional herbicides, though effective, often lack specificity and can harm non-target plants. In contrast, allelopathic compounds like (-)-carvone from spearmint offer a targeted approach. Based on these challenges, there is a pressing need to explore the mechanisms of these natural compounds to develop safer, more precise weed control methods that align with ecological preservation goals.

In a study published in *Horticulture Research*, a team from the Karlsruhe Institute of Technology, in collaboration with the University of Strasbourg, examined the allelopathic properties of (-)-carvone, a compound found in spearmint. The research demonstrates how (-)-carvone disrupts the microtubules in root meristems, leading to programmed cell death in target plants like cress and poppy. The findings highlight the compound's potential as a specific bioherbicide, offering a new direction in sustainable agriculture that minimizes environmental impact.

The study investigates the allelopathic effects of (-)-carvone, revealing its capacity to target and disrupt microtubules within the root meristems of plants. Microtubules, crucial for cell division and elongation, are dismantled upon exposure to (-)-carvone, particularly in the meristematic

cells, where the process starts and then progresses through the elongation zone.

This targeted disruption triggers programmed cell death, effectively halting the growth and germination of cress and poppy seeds. Unlike traditional herbicides that often exert non-specific toxicity, (-)-carvone operates via a signaling pathway, making it a promising candidate for a bioherbicide that could potentially reduce harm to non-target species.

The researchers utilized a root chip system to monitor this degradation in real time, providing clear evidence of the compound's specific action on plant microtubules. The study also compares the effects of (-)-carvone with (+)-menthofuran, another monoterpene, showing that (-)-carvone is significantly more effective, making it a prime candidate for further development in sustainable weed management.

Dr. Nathalie Hering, lead researcher from the Karlsruhe Institute of Technology, emphasizes, "Our findings with (-)-carvone present a groundbreaking approach to weed management. By specifically targeting the cytoskeleton of weed species, we can potentially develop bioherbicides that are both effective and environmentally friendly. This discovery opens new avenues for using natural compounds in sustainable agriculture, reducing our reliance on synthetic chemicals that often cause broader ecological harm."

The implications of this research are far-reaching, particularly in the field of sustainable agriculture. (-)-Carvone's ability to selectively target weed species without harming other plants could lead to the development of bioherbicides that align with ecological preservation goals. This approach not only addresses the growing concern over the environmental impact of conventional herbicides but also supports biodiversity. The successful application of (-)-carvone as a bioherbicide could revolutionize weed management practices, offering a natural, effective

alternative that minimizes ecological disruption.

More information: Nathalie Hering et al, Spearmint targets microtubules by (−)-carvone, *Horticulture Research* (2024). DOI: 10.1093/hr/uhae151

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