

Protocol on the mode of action of bioherbicides

Horse Mint oil to control vegetatively regenerating weeds

Allelopathic effects of Mints can be used as specific bioherbicides. Horse Mint oil induces a remodelling of actin filaments inducing programmed cell death in the target plant. This allows to control weeds that propagate vegetatively, such as Bindweed (*Convolvulus*). Application as pre-emergence compound is possible by using slow-release carriers.

State-of-the Art

Conventional herbicides are progressively challenged by evolution of resistant weeds and a negative public perception. Moreover, the pool of mode-of-actions has become progressively limited due to legal constraints that, in turn, were induced by the negative ecotoxicological footprint of numerous herbicides.

Mode-of-Action Studies

Advantage of Mint oil: the mode of action is based on hijacking signalling in the target plant, rather than a general toxicity, which allows for specificity. We could show that the essential oil of Korean Mint (*Agastache rugosa*), through its high content in menthone can disrupt microtubules with the consequence that cell expansion is blocked. The essential oil of Spearmint (*Mentha spicata*), through its high content in carvone, causes a specific perturbation of the mitotic spindle, which leads to inhibition of root growth in the target plant. Furthermore, we could show that the essential oil of Horse Mint (*Mentha longifolia*) disrupts actin filaments, triggering programmed cell death (a plant version of apoptosis) of the target plant.

Applications

The species spectrum of these essential oils and their compounds has been mapped. They are all more effective against broadleaf weeds with no negative impact on cereals. The oil of *A. rugosa* is very useful against *Rumex*, a prominent pasture weed in Switzerland and South Germany. The essential oil of *M. longifolia* is efficient against vegetatively propagating weeds with impact in biological agriculture of cereals, especially *Convolvulus*. The oils can be applied on slow-release carriers in pre-emergence.

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