

# Seed-eating weevils in clover seed production

## Development of odor-based strategies for control

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## Summary of the Final Report

Clover seed is fundamental within the agricultural sector, as clover is used in leys to produce animal fodder and as green manure. The latter is particularly important on organically managed farms where the use of inorganic fertilizers is prohibited. Seed-eating pest insects, predominantly *Apion* weevils, can cause yield losses of over 50 %. No established control measure exists within the organic sector. Pest management in clover seed production would be particularly well favored by developing odor-based control strategies. In this project our aim was to identify semiochemicals (pheromones and attractive floral volatiles) for different species of seed-eating weevils, with the end goal to develop efficient methods for monitoring and control. Our work focused on 1) scent collection and chemical identification of clover volatiles, 2) electrophysiology in *Apion fulvipes*, 3) behavioral lab studies, 4) field-collection of weevils and comparison to crop phenology, and 5) overwintering of weevils. Common compounds in clover included monoterpenes, C<sub>11</sub>-terpene hydrocarbons and sesquiterpenes. Moreover,  $\beta$ -ocimene (E and Z) increased over the season. Our electrophysiological screening of potential weevil attractants in *A. fulvipes*, specialized in white clover, found 18 classes of olfactory sensory neurons detecting several clover compounds. Our lab bioassays confirmed that odors are important for host plant choice in *A. fulvipes* and in *A. trifolii*, specialized in red clover. We also showed that females, but not males, prefer clover with buds and flowers. This result was consistent with our field collections of weevils, where number of females was positively correlated with number of buds. Presence of weevils in fields and field margins early in spring indicated weevil overwintering close to previous clover fields. In conclusion, our studies provided important basic knowledge on chemical communication and ecology in seed-eating weevils forming the foundation for future studies aiming to develop odor-based strategies for monitoring and control.