Laser Weeding with an Autonomous Vehicle

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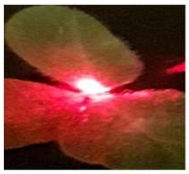

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Introduction: WeLASER is a European research project that **aims** to merge current technologies to build, assess and push into the market a precision weeding system based on high-power laser sources and autonomous mobile systems with the main objective of eliminating the use of herbicides while improving productivity and competitiveness (**Fig. 1**).

The laser: A 500 W thulium-doped fiber laser emitting at 2 µm wavelength is used because the radiation penetrates through the epidermis of plants cells, and is mainly absorbed by the water inside the plant in contrast to the energy from a CO_2 laser, which is solely absorbed on the surface of the plant.

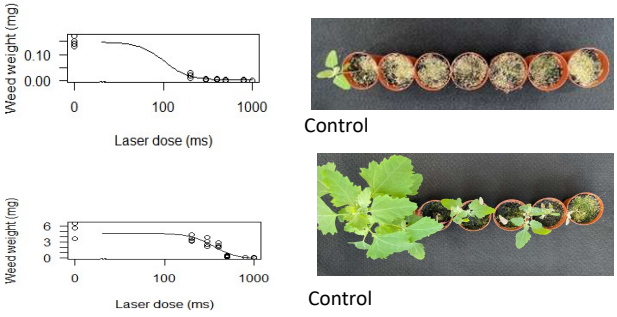

Fig. 2. Dose-response experiment with a 50 W fiber laser. *Chenopodium album* L. plants were exposed at the two and six leaf stage to various pulse lengths (n = 3) [1].

Artificial Intelligence (AI): AI is used to identify and locate crop and weed plants and direct the laser beam toward the meristems of the weed seedlings for real-time laser control.

Environment impact: Given the targeted nature of laser beams, the area exposed for weed control can be reduced substantially compared to other weed control methods. With a laser beam diameter of 2 mm and 100 weed plants m^{-2}, the direct exposed area is equal to 0.31% of the total area. Hence, the risk of affecting non-target organisms is low.

For more information visit: https://welaser-project.eu

Fig. 1. Autonomous mobile system equipped with lasers for weed control.

Energy and target

Only plants that threaten the crop yield or quality should be exposed, harmed or killed by the laser beams to avoid unnecessary energy consumption. Small weeds are more sensitive to lasers and require less energy than large plants. The best weeding result is obtained if the meristem of the target plant is exposed on the cotyledon stage or the two permanent leaf stage, at these stages, only the apical meristem is developed for most weed species. The larger the plants are, the more meristems are developed, and the ability to reestablish by sprouting from lateral meristems after the laser treatment increases (**Fig. 2**).

In contrast to mechanical weeding, the laser can hit weed plants very close to the crop plants without damaging leaves and roots due to the small laser diameter and ability to move the beam with advanced optics, as long as the meristem of the weed plant does not cover the crop plant.

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Reference:

1. Andreasen C, Scholle K, Saberi, M. 2022. Laser weeding with small autonomous vehicles: friends or foes? *Frontiers in Agronomy*. 2022 https://doi.org/10.3389/fagro.2022.841086