Using a 25 W diode laser to control annual ryegrass and turnipweed

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Summary The development of machine learning algorithms for precise weed detection is creating an opportunity to selectively apply non-selective physical weed control options. Recent research suggests energy intensive approaches can be used in large-scale cropping systems when applied as a site-specific treatment. Laser weeding is one such opportunity, whereby energy is tightly focused in a beam of light directed onto the weeds resulting in cell heating, rupture and death from the incident energy. Lasers are flexible in deployment with opportunities to adjust treatment length, beam qualities (width and intensity) and light wavelength through the type of optics and laser emission method. This precision targeting by laser weeding treatments provides a substantial advantage in energy use efficiency over other thermal methods such as flaming and microwaves. A 25 W, 942 nm diode laser was evaluated for control efficacy on annual ryegrass (*Lolium rigidum*) and turnipweed (*Rapistrum rugosum*) two representative winter weeds for the northern production region. A 15 and 60 second treatment provided control of both weeds at the 2-leaf and 4 to 6-leaf stages. When laser weeding did not result in plant death, plant biomass was severely diminished by longer treatments in early tillering ryegrass and 8 to 12-leaf turnipweed. An evaluation of larger beam diameters suggested larger diameters improved the ease of targeting the growth point with a lower requirement for precision placement. Using energy density to extrapolate from these results indicates that a laser of at least 400 W is needed for sub second control with a 10 mm beam diameter.

Keywords Site-specific weed control, weed detection, computer vision