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Physiological response of spring canola (*Brassica napus*) to defoliation in diverse environments

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ABSTRACT

Canola (*Brassica napus*) has recently been developed for dual-purpose use where vegetative biomass is removed by grazing animals, after which the crop recovers and is harvested for grain. Maintaining seed yield depends upon the timing and extent of defoliation in relation to plant development and the seasonal conditions for recovery and regrowth. We sought insights into the physiological basis for crop recovery and seed yield following defoliation using detailed growth analysis of plants defoliated in the diverse environments of southern Australia (35°S) and eastern Canada (45°N). The crop was defoliated by grazing with sheep in Australia and cutting by hand in Canada. Although canola development progressed more rapidly in the warm, long-day summer growing season of eastern Canada, developmental stages and biomass accumulation progressed at similar rates on the basis of photothermal time using a base temperature of 0 °C. Hybrid, conventional, and triazine-tolerant canola cultivars, with inherently different growth rates but similar phenology, showed little difference in their response to defoliation at any site. At all sites, recovery after defoliation was characterised by a rapid recovery in the absolute growth of leaves, a sustained reduction in stem biomass, but little impact on pod biomass. Despite this rapid recovery in leaf growth rates, leaf area and biomass in defoliated treatments recovered to only 50% of un-defoliated treatments prior to leaf drop, and reduced stem growth was manifested in reduced plant height (20–30 cm) at all sites. Despite the lack of response to defoliation in pod growth rate across all sites, final seed yield was reduced by defoliation in both years at Ottawa (by 0.6 t ha^{-1} or 25%) but not at the two Australian sites (Young and Wagga Wagga), except when the crop was affected by severe post-flowering water stress. Overall, the results from the Australian sites support previous observations of complete seed yield recovery in crops defoliated in the vegetative stage, provided sufficient time and reasonable conditions allow sufficient biomass recovery to fulfil the water-limited seed yield potential. In contrast, the Canadian crops did not recover seed yield following defoliation despite similar peak LAIs and more favourable regrowth conditions. Later defoliation after bud elongation, combined with accelerated development prevented the recovery of leaf area and biomass and reduced assimilation during pod-fill in defoliated plants.