Quantification of invasiveness in crops using demographic analysis

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New crops or crops with abiotic stress are currently being field-tested and may have significant economic and environmental benefits. However, potential invasiveness of these cultivars is of paramount concern in Canada and elsewhere. They may exhibit enhanced weediness in agricultural areas or invasiveness in ruderal (non-cropped disturbed) or natural areas and cause economic and environmental harm. To be invasive, a biotype must form self-sustaining, expanding populations within communities. Regardless of the underlying mechanism(s) of invasiveness, demographic analysis may provide a comparative measure of the ability of populations to expand in specific environments. It provides a compounded life-history measure of population performance, measured as lambda (λ), calculated from a matrix population model as the dominant Eigen value of the matrix. Populations with a growth rate having λ >1 are potentially invasive. Methodologies for quantification of invasiveness are being tested in 5 locations in Canada, in three disturbance regimes, with six representative species; Brassica napus, Camelina sativa, Medicago sativa, Triticum aestivum, Kochia scoparia and Thinopyrum intermedium. Seeds were individually positioned at two times, annually, in fall to quantify the ability of seeds to overwinter and produce seedlings, and in early spring to measure survival and fecundity. The lack of seed dormancy in most crop plants causes untimely (fatal) germination and reduces the success of seedlings in all environments. Despite considerable seed loss at harvest, most seed does not form a viable seedling. The λ values of species varied with the level of disturbance (agricultural to natural area) and with environment. This suggests that prior to release, invasive evaluations should to be conducted in representative environments, including both moderate and extreme climates. Demographic analysis provides a relatively simple to interpret metric for invasiveness that could be used to examine the effect of abiotic stress resistance on weediness.

Keywords: Invasiveness, Weediness, Demographic analysis, Abiotic stress resistance