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An international breeding program in spring canola

Wallace Cowling
J. Vuksic, R. Ezzy, J. Duguid, E. Gillis, O. Sass

The University of Western Australia, Perth, Australia

A diverse population of spring canola (Brassica napus L.) was improved during three cycles of recurrent selection for multiple economic traits in Australia and Canada. The founder population was composed of elite lines from the southern hemisphere (Australia) and northern hemisphere (Canada and Europe). Progeny were evaluated in Australia in cycle 1 (2014) and cycle 2 (2016), and in Canada and Australia in cycle 3 (2018). The across-cycle analysis was improved by including all genetic relationships (with crossing and selfing in the pedigree), additive and nonadditive genetic covariances between locations, and other fixed and random effects. Seed traits such as oil (%) and protein in meal (%) were moderately to highly heritable at 5 locations in Canada and Australia. Additive effects for oil and protein were positively correlated across locations and cycles both within Australia and between Australia and Canada. Blackleg resistance in disease nurseries in Australia was moderately heritable in 2016 but low in heritability in 2018 due to drought, but there was a strong positive correlation of additive effects for blackleg resistance across cycles. Grain yield was moderately heritable at all sites, and strong positive correlations of additive effects for grain yield were found within cycles in 2016 (two sites in Australia) and in 2018 (one site in Australia and one in Canada). Inter-cycle correlations of additive effects for grain yield were low or negative. An index based on economic value per hectare was constructed from several traits and used to generate mating designs based on optimal contributions selection. The index included average additive effects for grain yield across all locations and years. The optimised mating design predicted an increase in index value of +AU$177/ha in the population in the next cycle, including grain yield improvements in Canada and Australia of >1% p.a. averaged across cycles. There were predicted improvements in the next cycle for seed oil (+0.5%), meal protein (+0.4%), and blackleg resistance, and reductions in height and flowering time. This international breeding program produced significant genetic improvements of value to both hemispheres in spring canola.