EARLY GENERATION SELECTION EFFICIENCY IN SPRING CANOLA AND RAPESEED (*Brassica napus* L.)

by

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ABSTRACT

Despite many advances in traditional genetics and molecular biology techniques, the majority of new canola or rapeseed (*Brassica napus* L.) cultivars are developed using similar recurrent phenotypic selection techniques to those used 100 years ago. Greatest advances in plant breeding are achieved by selection amongst breeding lines with greatest genetic diversity. Therefore, selection is frequently conducted in the early segregating generations of breeding schemes, where greatest genetic diversity exists. However, it is common to screen thousands of lines at these stages and evaluation is regularly carried out on small plots, often single plants. In addition, progeny at these early segregating stages are highly heterozygous, and phenotypic performance can be greatly affected by dominance effects. To date, few researchers have examined efficiency of early generation selection in spring canola or rapeseed breeding. In this study, the efficiency of early generation selection is examined using single line selection, and cross prediction breeding techniques with F_1 and F_2 greenhouse grown plants and F_2, F_3, and F_4 field grown plants.

Twelve genetically diverse *B. napus* cultivars (nine canola varieties, and three rapeseed varieties) were hybridized in all possible cross combinations (half-diallel, with selfs) to produce F_1 seed from all 66 possible crosses. In the fall of 1998, F_1 seed was planted, along with the original 12 parental lines, in a randomized complete block design with three replicates and two plants per replicate. Throughout the growth of these plants, a number of pre-harvest were evaluated, and after harvest seed yield, thousand seed weight, and oil quality characteristics were recorded. In the spring of 1999, the greenhouse experiment was repeated, but in this case F_2 seed was planted rather than F_1

seed. In 2000, all 396 F_2 and 396 F_3 lines, along with eight replicates of each parent, were planted in field plots in a nested, single replicate, strip plot design. Each plot was evaluated for all characters previous recorded. In the spring of 2001, the following F_3 and F_4 lines were planted at two locations and characters evaluated.

Efficiency of selection was examined using estimates of heritability from correlation and response from selection. Correlations between characters were examined to evaluate the possibility of indirect selection. The efficiency of cross prediction methods also was examined.

Oil quality and seed oil content had high heritability in greenhouse F_1 and F_2 generations and thus could be effectively selected in these early segregating generations, despite the atypical glasshouse environment. Days to first flower, plant height, plant maturity, and breeders' preference had heritabilities that would allow for moderate selection in the field F_2 generation. Seed yield and plant establishment can not be efficiently selected for even in the F_3 generation of a canola and rapeseed breeding program. More effective selection is obtained when selection is performed in both the F_2 and F_3 generations with less intensity than postponing selecting until the F_3 generation at a higher intensity. Despite each cross being represented by only six progeny, cross prediction selection methods were shown to be more efficient than single line selection for all traits examined. The potential of using cross prediction techniques to identify "superior" parents also needs further study.