

Investigation of Heterosis in Spring and Winter Canola (*Brassica napus* L.)

By: Kathleen P. McGee
December, 1994

Major Professor: Jack Brown, Ph.D.

ABSTRACT

Several crop species have shown heterotic yield increases when hybrids are compared to inbred cultivars; however, it remains to be proven that hybrid canola (*Brassica napus* L.) offers any economic yield, oil content or oil quality advantage compared to traditional inbred cultivars. The purpose of this study was to examine heterosis and its genetic basis in spring and winter canola types, as well as to determine which pre-harvest and post-harvest characters were responsible for any heterosis observed. Heterosis was specifically investigated for yield, oil content and oil quality.

For each canola type, four inbred parental lines of diverse origin were hand-pollinated in a half-diallel design to obtain F₁ seed from all possible (6) cross combinations. A portion of F₁ and parental seed was increased to the F₂ generation under greenhouse conditions. Performance of spring and winter F₁ hybrids and their respective parental lines was evaluated in the greenhouse in 1992 and 1993, respectively. Field trials were conducted with spring canola F₁ and F₂ seed in 1993, and winter canola F₁ and F₂ trials were planted in 1993 and harvested in 1994. F₁ field trials were grown at one site with smaller plots than F₂ trials, which were grown at two sites.

Heterosis was examined in several ways. One method involved comparing the average performance of parental lines with the average performance of the F₁ hybrids; a similar investigation compared average parent performance with the average hybrid productivity at the F₂ generation; the last method compared F₁ and F₂ generations grown at the same site adjusted according to average parental performance within each respective trial.

All methods of comparison showed positive heterosis for yield, oil content and oil quality in both spring and winter canola, with yield attaining the greatest degree of heterosis. However, the degree of heterosis observed in individual hybrid crosses varied between environments and according to which comparison method was utilized. Furthermore, pre-harvest characters and yield components which may have contributed to observed heterosis varied between environments.

Genetic analyses were carried out to explain the increased productivity of hybrids over inbred parents. In these analyses, the proportion of genetic variation accounted for by additive gene action, dominance (directional and non-directional) or by non-additive/dominance effects (*i.e.*, epistasis, linkage or interaction effects) was examined. Inconsistency of major factors affecting observed heterosis was due to dominance, although there were a few instances where epistasis or interaction effects had greatest control of character expression.

Overall, the results of this study suggest that, within individual hybrid crosses, sufficient heterosis for yield exists to justify pursuing hybrid development in both spring and winter canola. However, proper parental selection is of critical importance, as is development of improved commercial hybrid seed production methods, if hybridity is to be maximized.