Comparative adaptation of canola (*Brassica napus*) and Indian mustard (*B. juncea*) to soil water deficits

by

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"It droppeth as the gentle rain from heaven
Upon the place beneath: it is twice bless'd"
-The Merchant of Venice, William Shakespeare

Preface

I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree.

I certify that any help received in preparing this thesis, and all sources used, have been acknowledged in this thesis.

Philip Richard Wright

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Abstract

Canola (*Brassica napus*) has become an increasingly important crop in Australia, although it is poorly adapted to dry environments. Indian mustard (*B. juncea*) is reputed to be better adapted to these environments and may be a suitable alternative crop in these areas. However, very little is known about the comparative performance of these crops or the basis for differences in adaptation. The work reported in this thesis set out to examine these questions and to provide at least a preliminary understanding of any observed differences.

Five experiments were conducted comparing growth, yield, water use and plant water relations, chiefly under field conditions in northern NSW. At least three genotypes of each species were used in the field experiments and all were matched for phasic development and height in the main experiments.

Mustard produced more above ground dry matter than canola (between 9 and 120%) with the biggest relative difference occurring at the greatest soil water deficit. Mustard yielded more than twice as much seed as canola under these conditions while there were no yield differences at low deficits. Components of yield differed between the two species with mustard having more pods per plant but fewer seeds per pod and a lower harvest index. Differences in these factors could not explain mustard's yield advantage, which was due to its greater dry matter production.

The advantage in dry matter production was related to greater early vigour and an ability to maintain longer leaf area durations under water deficits. Differences in early vigour were associated with a greater rate of leaf expansion which arose from differences in leaf morphology, with mustard having smaller specific leaf weights. Water use efficiencies for seed and dry matter production were higher in mustard. Some evidence of higher transpiration efficiency in mustard was also found, both at a leaf and canopy level. Neither leaf stomatal density nor epidermal conductance could explain differences in transpirational efficiency, these differences were concluded to result from a greater photosynthetic rates per unit leaf area.

Leaves of mustard were found to have higher turgor than those of canola particularly under water deficit conditions. Turgor maintenance in mustard was shown to be related to a greater capacity to accumulate solutes under these conditions. Differences in turgor were related to differences in dry matter production and may also be related to differences in water use efficiency. The results of these studies are consistent with osmoregulation being an important trait in mustard's greater adaptation to water deficits. It is recommended that work be continued on developing mustard as a crop in its own right for Australian conditions.

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