Indian Mustard (Brassica juncea) - A better adapted alternative crop to Canola in the low rainfall cropping regions of Western Australia

**Summary**

Indian mustard (*Brassica juncea*) was considered a potential ‘new’ crop suitable for the low rainfall cropping regions of the Western Australian (WA) grainbelt. Mustard produces a high quality oil and has a number of important agronomic advantages over canola. These include vigorous seedling growth, rapid canopy development, greater tolerance to heat and water stress, resistance to shattering and improved resistance to fungal diseases (e.g. blackleg) and insect pests. These characteristics, particularly its high tolerance to heat and water stress, makes it a better alternative crop to canola in the low rainfall zones. In recent years, mustard lines with near-canola quality oil have been developed by the National Brassica Germplasm Improvement Program (NBGIP), based at Horsham, Victoria (VIC).

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Conclusions
This project demonstrated that although mustard showed significantly better growth, dry matter production and superior physiological adaptation to drought than canola in the low rainfall regions of the WA grainbelt, the mustard genotypes tested did not outyield canola due to their lower harvest indices and poor yield component structure compared to canola.

Recommendations
It is recommended that the NBGIP should consider undertaking further breeding work on mustard to modify its morphology and yield component structure. Breeding for plants with shorter stature and higher number of pods per plant and seeds per pod, along with seed with oil quality and concentration similar to canola, is recommended.

Outcomes
Economic Outcomes
Steps towards the development of mustard as a new crop for the low rainfall regions will broaden the choice of oilseed crops available to growers and will ultimately contribute to the productivity of farming systems in the low rainfall cropping regions of WA and other states.

Environmental Outcomes
Mustard varieties with good adaptability to low rainfall regions will make it an attractive crop to grow in rotations. This will translate into greater sustainability of farming systems in the low rainfall cropping regions of WA and other states.

Social Outcomes
Adoption of mustard by growers in the low rainfall cropping regions of WA and other states will result in developing another new cropping industry in these regions.

Achievements/Benefits
Indian mustard (B. juncea) was considered a potential 'new' crop suitable for the low rainfall cropping regions of the WA grainbelt. Mustard produces a high quality oil and has a number of important agronomic advantages over canola. These include vigorous seedling growth, rapid canopy development, greater tolerance to heat and water stress, resistance to shattering and improved resistance to fungal diseases (e.g. blackleg) and insect pests. These characteristics, particularly its high tolerance to heat and water stress, make it a better alternative crop to canola in the low rainfall zones. In recent years,
mustard lines with near-canola quality oil have been developed by the NBGIP.

Mustard was better adapted to low rainfall environments compared to canola. Mustard genotypes 887.1.6.1 and 82 No 22-98 showed general adaptability by producing the highest mean seed yield across environments and showed average phenotypic stability across all environments. Low yielding mustard genotypes, JM 25 and JM 33, were best adapted to low yielding environments and showed above average phenotypic stability. However, as the 2002 field experiments in Merredin, Mullewa and Newdegate had to be abandoned due to the severe drought, further research needs to be carried out before mustard varieties/lines with superior adaptation, yield and quality for the low rainfall environments of WA are identified.

Mustard and canola sown early in the season in low rainfall environments produced higher yields and oil concentrations. Longer growing season and longer post-anthesis duration were favourable for higher yields. Higher rainfall during post-anthesis phase, warmer pre-anthesis phase and cooler post-anthesis phase improved yield in these environments. Mustard demonstrated greater physiological adaptation to drought than canola. This was related to its superior osmotic adjustment, lower leaf water potential, higher stomatal conductance, maintenance of leaf area and reduced rate of leaf senescence by increasing both avoidance and tolerance of dehydration - and thereby increased radiation use, increased water use by stomatal adjustment and increased soil moisture uptake by producing deeper roots.

For further details, see published papers in Attachments.

Other research

Further breeding and selection in mustard is required to modify its morphology and yield component structure. Early generation (F2 or F3) materials from such breeding programs should be evaluated in key target environments in order to identify genotypes suitable to specific environments. Mechanisms underlying mustard’s greater dry matter production, particularly photosynthetic activity under water stress, require further investigation. More agronomic research is required to further improve yield and oil concentration in mustard.