

University of Southern Queensland

**Use of Marker Assisted Selection for the
Introgression of Quality Traits from Australian into
Chinese Wheats**

A Dissertation Submitted by

Benedette Watson

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Abstract

Quantitative Trait Loci (QTLs) for polyphenol oxidase and xanthophyll have a significant impact on variation in wheat flour for noodle colour and colour stability. QTLs from two Australian wheat cultivars, Sunco and Tasman, have been backcrossed into two Chinese wheat varieties, Chuanmai 22 and Mianyang 11, to assess marker predictability for these important traits in significantly different genetic backgrounds. The concept of Marker-Assisted-Selection (MAS) is being trialled in this study as a proposed method for wheat improvement. In this approach molecular markers are used in conjunction with backcross breeding methods to introgress specific characters into elite breeding materials, with the goal of improving the quality attributes of wheat for the Asian noodle market. After three single seed descent generations, the backcross populations generated allow four QTLs to be investigated. These include two for polyphenol oxidase (chromosome 2A and 2D) and two for xanthophyll (chromosome 3B and 7A).

This research was successful in identifying microsatellite markers that are capable of predicting PPO activity levels and Xanthophyll content within the backcross populations. These microsatellites were validated as useful

markers for these quality traits, as they have also found to be important in the Sunco x Tasman doubled haploid population. The combination of marker assisted selection and backcrossing has generated three lines that contain different combinations of the PPO activity and Xanthophyll content QTLs. These lines have been found to produce low levels of PPO activity and have a low Xanthophyll content. This improvement in flour colour and colour stability highlights the potential of marker assisted selection as a useful tool in wheat breeding.

Declaration

I certify that the ideas, experimental work, results, analyses and conclusions reported in this dissertation are entirely my own effort, except where otherwise acknowledged. I also certify that the work is original and has not been previously submitted for any other award, except where otherwise acknowledged.

.....

Date:

Signature of Candidate

Benedette Watson

(nee Cavallaro)

ENDORSEMENT

.....

Date:

Signature of Supervisor

Professor Mark Sutherland

Previously Published Material

Some of this work has been previously presented at scientific conferences.

Cavallaro, B., Storlie, E., Sutherland, M.W., Mares, D., Sheppard, J., & Banks, P., (2004) Backcrossing QTLs from Australian to Chinese wheats, Wheat Breeding Society of Australia, 11th Assembly, Canberra ACT.

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While working as a Research Assistant I commenced this master's project part-time in 2002. Over the following six years a few major events occurred that significantly slowed the completion of this master's thesis. I was married in the end of 2004, so that warranted a little holiday. But it was in March of 2006 that my study life was successfully slowed to a halt by the arrival of our son, Noah. At this time I took a leave of absence from study and concentrated on the important job of being a new Mum. The final distraction was during the first six months of 2008 when we all travelled to Oxford, UK where my husband, Dr Mike Watson, spent a sabbatical leave.

It has been an eventful seven years after deciding to commence this master's project. And it wouldn't have been possible without the support and guidance from many people along the way.

This project came about through a large Australian Centre for International Agricultural Research (ACIAR) funded project entitled "Wheat Improvement in Sichuan Province" (1999-2006) on which I was employed as a research assistant. This large project coordinated by Mark Sutherland at USQ, was based on a close collaboration with the Crop Research Institute within the Sichuan Academy of Agricultural Sciences (SAAS), located in Chengdu, China, the Leslie Research Centre (QDPI & F), the University of

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