THE INFLUENCE OF SEEDING DENSITY AND ENVIRONMENTAL FACTORS ON GRAIN QUALITY OF MAIN STEMS AND TILLERS OF WHEAT IN SOUTH AUSTRALIA

(WITH SPECIAL REFERENCE TO

PRIME HARD QUALITY WHEAT)

A thesis submitted for the degree of Doctor of Philosophy

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ABSTRACT

Prime Hard wheat, a high protein hard wheat classification of the Australian Wheat Board, has traditionally been grown in Queensland and the northern areas of New South Wales. Recently there have been moves to extend this area into the more southern regions of the wheat belt, to expand production of this grain and for greater reliability of supply. The emphasis of this thesis is on the opportunities and constraints to Prime Hard wheat production in South Australia. The environmental factors affecting wheat crops in South Australia are different to those in the traditional Prime Hard producing areas, with heat and moisture stress likely to be the most important climatic influences. Management practices such as the recent trends towards higher seeding densities could also be important (influencing main stem and tiller ratios).

An experiment using controlled temperature and moisture conditions showed that main stems and tillers differed in their responses to post-anthesis heat and drought. A field experiment with moisture stress as the only treatment also showed differences in harvest parameters and grain quality between main stems and tillers.

Grain produced from field plots at different plant densities showed significant differences in a number of quality measurements, the most important being 1000-grain weight and flour colour. Less screenings and higher 1000-grain weights were obtained from plots with higher seeding rates. However, flour from plots with higher seeding rates had slightly more yellow colour.

When main stems and tillers from these plots were tested separately, using small-scale equipment, grain weight and flour colour also differed between main stems and tillers. Main stems produced larger grains than tillers, as expected, and tillers

produced grains with yellower flour. The smaller grain size and yellower flour of the tillers is attributed to the higher degree of stress likely to be experienced by tillers, as they have later anthesis dates and are more likely to experience moisture, and/or heat stress at a critical stage of grain filling. Plants with more tillers, such as those grown in a low-density crop, have a later average anthesis date than an equivalent crop of higher seeding density, with more main stems. Therefore it is likely that increasing seeding density will give a shorter crop ripening period and a more uniform seed quality. However, care must be taken not to exceed the optimum plant population density.

In conclusion, the experiments showed that tillers are more sensitive to conditions of moisture or heat stress than main stems, and that they make a measurable contribution to the quality of a wheat crop. Increasing the crop density decreased the proportion of tillers present, leading to a more uniform crop and less screenings at harvest. Increased competition in high-density crops may result in slightly more yellow flour, but dough and loaf quality were not affected.

DECLARATION

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

I give consent to this copy of my thesis, when deposited in the University Library, being available for loan and photocopying.

Rebecca E. Tonkin

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