ISOLATION, CHARACTERISATION AND QUALITY TESTING OF 1DS/1RS WHEAT-RYE RECOMBINANTS

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ABSTRACT

The incorporation of agriculturally useful genes into wheat from distantly related and uncultivated relatives has attracted much interest among wheat breeders over recent decades. Cereal rye, especially the short arm of rye chromosome 1R, is known as a useful source of genes for disease resistance and enhanced agronomic performances.

However, despite the numerous beneficial effects associated with these wheat-rye translocation lines, their inferior bread making quality has severely limited the use of this breeding material in some countries, including Australia. Several approaches have been used to eliminate or reduce these deleterious effects on the quality of wheat-rye translocation lines whilst still retaining the disease resistance character.

This research project had two overall objectives. The first study was to investigate the production of new wheat-rye recombinant lines carrying different lengths of rye chromosome in 1DL.1RS translocation lines. Secondly, this study attempted to elucidate the cause of the quality defect in 1DL.1RS wheat-rye recombinant lines by assessing the quality of each recombinant which carried different lengths of the rye 1RS chromosome segments.

The main objective was to produce recombinant lines with a smaller interstitial rye segment carrying the rye stem rust resistance gene and lacking as much other rye chromatin as possible. Following a previously published procedure, an experiment was carried out to select for recombination between the *Sec-1* and closely linked *SrR* loci by inducing a second round of homoeologous recombination in the derived

recombinant DRA-1 which already possessed all the known wheat storage proteins on chromosome arm 1DS.

The number of confirmed wheat-rye recombinants detected was low giving a frequency of 0.1%. Two new recombinants found from this study carry the least amount of rye chromatin resulted from splitting the rye segment of the derived recombinant DRA-1. Recombinant T6-1 (*Sec-1*$^{-}$*SrR*$^{+}$) will be the most critical recombinant, since it only carries the target gene for stem rust resistance without secalins. On the other hand, R49-7 (*Sec-1*$^{+}$*SrR*$^{-}$) is not expected to be of direct value in wheat breeding since it contains secalins and does not possess the stem rust resistance gene. However these recombinants are valuable sources for determining whether the secalin gene is a contributing factor towards the quality defect in translocation lines involving 1RS chromosome.

The availability of different types of 1DL.1RS wheat-rye recombinants with different lengths of rye segment has provided a valuable resource to elucidate the factors involved in the low quality, especially the low dough strength, in these wheat-rye recombinants. However, it has not given a simple answer as to the role of *Sec-1* gene in this problem.

In general, the dough quality parameters, especially dough strength of recombinant lines, were significantly better than the original translocation 1DL.1RS, but still less than the normal wheat cultivar Gabo.

In summary, many factors contribute to the bread-making quality of wheat-rye recombinants. The recombinant, which has all the wheat storage proteins with the shortest rye chromatin containing stem rust resistance gene without the inclusion of rye secalins will be the most useful, as has been produced in this study.