THE UNIVERSITY OF ADELAIDE

FACULTY OF AGRICULTURAL SCIENCE

WHEAT : BARLEY HYBRIDIZATION AND THE PRODUCTION AND CHARACTERIZATION OF ADDITION LINES

by

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SUMMARY

This thesis reports work on wheat:barley hybridization and the subsequent isolation and characterization of addition lines having individual pairs of barley chromosomes added to the chromosome complement of hexaploid wheat.

It was found that wheat and barley can be hybridized without difficulty when barley is used as the female parent and self-sterile F_1 hybrids with 28 somatic chromosomes were obtained using *in vitro* culture of embryos. Although no fertile sectors were produced after treatment of the F_1 hybrids with colchicine, some backcross (BC_1) seeds were obtained after pollinating them with wheat pollen. The majority of the backcross progeny were 49-chromosome heptaploids which evidently originated from fertilization of egg cells which had restituted at meiosis. Putative monosomic addition lines were isolated in the second backcross (BC_2) progeny of the self-sterile BC_1 plants. However, these plants were all self-sterile and exhibited pistillody due to an unfavourable interaction between barley cytoplasm and the wheat genome.

To overcome this problem of pistillody the more difficult reciprocal cross was attempted and although 20 hybrids were obtained in 8133 crosses, only one of them possessed the expected complement of 28 chromosomes which exhibited 28' at meiosis. The others possessed chromosome numbers varying from 21 to 36 in different plants. Presumably these abnormal plants originated from disruption of normal spindle activity during early divisions of the zygote. The 28-chromosome normal wheat x barley hybrid behaved similarly to the reciprocal hybrids in the BC_1 and BC_2 generations, except there was no evidence of pistillody and most of the BC_2 plants were self-fertile with this

cross. Five different monosomic addition lines were detected among BC_2 progeny and all of these plants were self-fertile. Disomic addition lines were isolated from among the progeny of these 43-chromosome monosomic additions and some other 44-chromosome double monosomic additions. Altogether five disomic and six ditelosomic additions were obtained from the progeny of these plants. Another disomic and a ditelosomic addition were obtained separately from three unusual hybrids exhibiting 22', 21' + 1" and 25' + 1"', at meiosis.

In this work, a new method for producing disomic addition lines from monosomic additions, was developed using Hordeum bulbosum crosses. The monosomics were crossed with H. bulbosum and 22-chromosome aneuhaploids were selected from among the progeny and disomic additions were then obtained directly from them by colchicine doubling.

The six disomic addition lines were initially designated A to F according to their sequence of isolation. Later N-banding was applied to barley chromosomes and it was found that each chromosome has a distinctive pattern, and furthermore, these patterns are all different from those exhibited by wheat chromosomes. Thus by studying the N-banding pattern of the chromosomes in the addition lines it became possible to determine which standard barley chromosome was present in each line. It was found that addition line A,B,C,D,E,F possesses standard barley chromosomes 4,7,6,1,2 and 3 respectively.

The remaining addition line (5) could not be obtained in disomic form, because chromosome 5 of barley when added to wheat results in cytological disturbances such as mosaic pollen mother cells and multi-pore pollen grains, and lines carrying it are self-sterile. The isolation of a fertile line carrying a translocation chromosome with

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the short arm of chromosome 5 of barley joined to an unidentified arm of a wheat chromosome, showed that the sterility factors must be located on the long arm of chromosome 5.

It is evident that six out of the seven possible disomic additions and seven out of the 14 possible ditelosomic additions have been obtained. These addition lines will be useful in assigning genes controlling barley characters to particular barley chromosomes and also in determining the genetic similarity of individual barley chromosomes with wheat chromosomes. Furthermore, such addition lines could serve as the source material for transferring desirable characters from barley to wheat.