M. Feldman

Rao, M.V.P

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HOMOEOLOGOUS RELATIONSHIP OF IMPERIAL RYE CHROMOSOME C WITH WHEAT CHROMOSOME 4A

M.V. PRABHAKARA RAO
Biology and Agriculture Division
Bhabha Atomic Research Centre, Bombay-85, India.

SUMMARY

Monosomic and disomic substitution of Imperial rye chromosome C for Chinese Spring wheat chromosome 4A were obtained. The restoration of vegetative vigour and partial fertility in the substitution lines is evidence of homoeology of rye C for wheat 4A. Hence rye chromosome C (chromosome IV after Riley) can be redesignated as 4R.

INTRODUCTION

It is possible to allocate each of the seven chromosomes of rye to different homoeologous groups. Homoeologous relationships have been demonstrated for rye chromosome 2R (III), 3R (VI), 5R (I) and 6R (II). The remaining three rye chromosomes IV, V and VII (Riley's designation) should fall into groups 1, 4 and 7 (Sears, 1968). Based on the location of ADH (alcohol dehydrogenase) gene, Irani and Bhatia (1972) indicated that chromosome IV of rye variety Ming II is related to group 4 chromosomes of wheat. Irani and Bhatia (unpublished) found that Imperial rye chromosome C (Sears'

designation) carries the ADH gene. The present study based on genetic compensation in a substitution line provides final confirmation for redesignating Imperial rye chromosome C as 4R.

MATERIALS AND METHODS

The following wheat lines used in this study were kindly supplied by Prof. E.R. Sears, University of Missouri, Columbia, Mo., U.S.A.:-

(1) Chinese Spring wheat with an added pair of Imperial rye chromosome C.

(2) Chinese Spring monosomics 4A, 4B and 4D.

RESULTS AND DISCUSSION

Chinese Spring wheat carrying an added pair of Imperial rye chromosome C was first crossed to monosomics 4A, 4B and 4D. 42-chromosome F_1 plants were identified cytologically in each cross. All such plants showed $20^{II} + 2^{I}$ and no pairing was observed between the wheat and rye univalents. The rye univalent was longer in size than wheat univalent and so it could be identified easily. The selfed progenies of these selected F_1 plants were screened cytologically and a substitution plant was obtained only in the cross involving mono-4A.

Selfed progeny of a plant with $20^{II} + 2^{I}$ (4A, C) consisted of 12 plants of which 11 were fertile and one was partially sterile. Among the fertile plants, two had 21^{II}, eight had

$20^{II} + 1^{I}(4A)$ and one had $20^{II} + 2^{I}(4A, C)$. The partially sterile plant had $20^{II} + 1^{I}(C)$ with the rye univalent being significantly long. Selfing of this substitution monosomic gave rise to two substitution disomics (21^{II}), five substitution monosomics ($20^{II} + 1^{I}$) and eight nullisomics (20^{II}). The high frequency of nullisomics indicates that rye chromosome C does not compensate fully for 4A in the pollen. But the recovery of two disomic substitutions indicates that pollen with the rye chromosome does function occasionally.

Chinese Spring nullisomic for 4A has very narrow leaves, thin culms, reduced plant height and complete sterility. Both the monosomic and disomic substitutions had normal vegetative vigour and partial fertility (Table I and Fig. 1). The restoration of partial fertility in the substitution lines indicates homoeology between rye chromosome C and wheat 4A.

Wheat chromosomes of homoeologous group 4 carry $\underline{Adh}_A$, $\underline{Adh}_B$ and $\underline{Adh}_D$ genes (Hart, 1970). Irani and Bhatia (1972) found that King II rye chromosome IV (equivalent to Imperial rye chromosome C) carries the $\underline{Adh}_{R2}$ gene indicating its relationship with group 4 chromosomes of wheat. Bielig and Driscoll (1973) reported on a monosomic alien substitution line involving substitution of Imperial rye chromosome D for chromosome 4B of Chinese Spring wheat. The substitution line

Table I

Spike fertility in substitution lines

Material		Spike fertility (No. of seeds/spikelet)
Chinese Spring Control	(2n=42)	2.45
Nullisomic for 4A	(2n=40)	0
Monosomic substitution for C for 4A	(2n=41)	0.14
Disomic substitution of C for 4A	(2n=42)	0.85

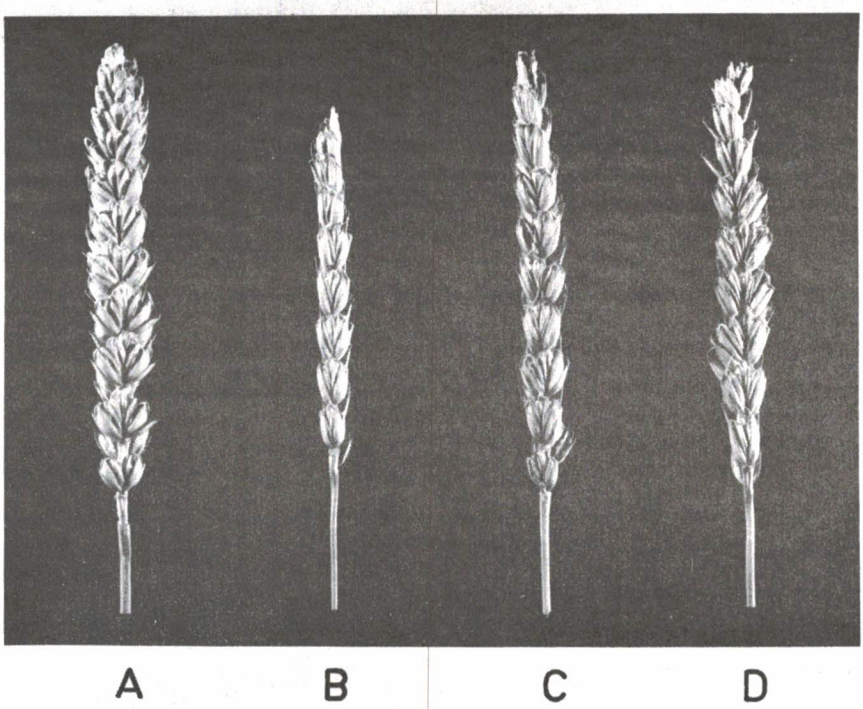

Fig.1-Spikes of A. Chinese Spring Control
B. Nullisomic 4A
C. Monosomic substitution of C for 4A
D. Disomic substitution of C for 4A

showed good vegetative vigour. Darvey (1973) in his tentative placement of rye chromosomes into their homoeologous groups included rye chromosomes C and D in both homoeologous groups 4 and 7 indicating a translocation involving C and D. The present study indicates that Imperial rye chromosome C substitutes reasonably well for wheat chromosome 4A and hence it can be redesignated as 4R. Even if C is a translocated chromosome, it should be largely 4R since the degree of compensation of C for 4A is very good.

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