TRANSFER OF LEAF RUST RESISTANCE INTO BREAD WHEAT FROM *TRITICUM TIMOPHEEVI* ZHUK

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ABSTRACT

Selections have been derived from an interspecific hybrid between hexaploid bread wheat (*Triticum aestivum* L.) variety NI 5439 and the tetraploid wheat *T. timopheevi*. The F_1 was backcrossed to the bread wheat parent and was followed by seven generations of selfing. The selections exhibit a high level of field resistance at adult plant stage to leaf rust (*Puccinia recondita*) and seedling resistance to 11 Indian leaf rust virulences. These selections will be a valuable source of leaf rust resistance.

INTRODUCTION

TETRAPLOID wheats possess several desirable attributes for improvement of bread wheat. *Triticum timopheevi* Zhuk. ($2n = 4x = 28$, genome AAGG) offers an excellent source of disease resistance particularly against rusts[1–5]. Several workers have made successful transfers of rust resistance from *T. timopheevi* to *T. aestivum* L. ($2n = 6x = 42$, genome AABBDD)[6–9]. For leaf rust only one gene, *Lr*18, has so far been transferred to bread wheat from *T. timopheevi* and is present in Timvera, Red Egyptian and Africa 43. Thus *T. timopheevi*, remains largely untapped for leaf and stripe rust resistances. The transfer of leaf rust resistance from *timopheevi* to common wheat is the subject of this communication.

MATERIALS AND METHODS

Bread wheat variety NI 5439 was crossed to a leaf rust-resistant strain of *T. timopheevi* Zhuk. var. *viticulosum*. The pentaploid F_1 hybrid was backcrossed to NI 5439. Chromosome numbers of many plants in BC_1 generation were determined. Near hexaploid ($2n = 37$ to $2n = 41$) plants which showed high resistance to leaf rust at adult plant stage were selfed and their subsequent generations were screened for rust resistance under natural and artificially created epiphytotic conditions at Wellington in South India which is a 'hot spot' location for rusts and other foliar diseases of wheat. The last two generations were also screened under artificial epiphytotic conditions by inoculating the field with 14 physiological virulences of leaf rust, viz 11, 12, 12A, 20, 77, 77A–1, 77–2, 104, 104A, 104B, 104–1, 108, 162 and 162A. Segregants showing high degree of resistance to leaf rust at adult plant stage were carried forward. Cytologically stable lines ($2n = 42$) in BC_1–F_7 generation, and the variety NI 5439 were tested for seedling reactions to 13 individual Indian leaf rust virulences. Inoculation techniques described by Stakman *et al*[10] were used. The infection types were recorded 12–15 days after inoculation, using the scale devised by Stakman *et al*[11]. The material was tested at an average glasshouse temperature ranging from 15°C to 20°C.

RESULTS AND DISCUSSION

The pentaploid F_1 hybrid of NI 5439 × *T. timopheevi* exhibited mesothetic reactions of moderate intensity. From the BC_1 generation onward, segregants showing high degree of adult plant resistance were carried forward. The adult plant reactions of selections to leaf rust recorded at Wellington as well as New Delhi, under natural and artificially created epihytotic conditions are given in table 1. All the selections showed a high level of resistance to leaf rust at adult plant stage. The selections have also exhibited seedling resistance to nine physiological virulences (table 2) to which NI 5439 showed susceptibility. Two selections, 377–213–725 (Hry) and 541–278–772, showed infection type 0; 1–2 to all the virulences included in the study. The resistance has been obviously derived from *T. timopheevi*.

There are only a few reports of transfer of leaf rust resistance from *timopheevi* to common wheat. Allard and Shands[7] transferred stem rust resistance of *timopheevi* into common wheat producing genetic

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Table 1 *Adult plant reactions* of T. timopheevi-derived selections and checks to leaf rust*

Selections checks	Wellington (*kharif*-1986)	New Delhi (*rabi*-1985–87)
67–64–609	20 MS	10 MS
174–133–671 (Hry)	20 MR	5 MR
134–671–4 (spelt)	10 MS	5 MS
377–213–725 (Hry)	5 MR	TR
434–227–735 (Hry)	5 X	TX
541–278–772	TX	5 MR
598–305–780	5 MS	10 MS
623–314–782	10 MR	10 MS
643–319–783	20 MS	10 S
NI 5439	80 S	70 S
Triticum timopheevi	0	0
Africa 43 (*Lr*18)	60 S	50 MS
Red Egyptian (*Lr*18)	60 S	60 MS
Timvera (*Lr*18)	70 S	50 MS

* The rust reactions were recorded by combining severity (percentage of infection) and response (type of reaction).

stocks CI 12632 and CI 12633. These stocks were incidentally resistant to leaf rust also. Bartos and Sebasta[12] transferred leaf rust resistance from *timopheevi* to two Czhecoslovakian wheat varieties. The gene of *T. timopheevi* that imparts resistance to many Australian races of leaf rust is *Lr*18[13]. However, this gene does not confer adult plant resistance to leaf rust (table 1) at Wellington or New Delhi. *Lr*18 is also ineffective to 11 Indian leaf rust virulences (table 2) at seedling stage[14]. It is thus indicated that the resistance in these selections is due to a new resistance factor(s) derived from *T. timopheevi*. Inheritance of rust resistance in these selections is under study. Most of the selections are morphologically similar to NI 5439 except a few which are hard threshing. Some of these selections carry lower leaves that are pubescent like those of *T. timopheevi*. The seed size and 1000-kernel weight is comparable with that of NI 5439.

The early segregating generations were selected on the basis of adult plant reactions. It was noted that the leaf rust virulences, 12, 12A, 77, 77A, 77B, 104, 104A, 104B, 162 and 162A were predominant in Wellington during 1983–85. These selections exhibited seedling resistance to all virulences except 162 and 162A. However, the selections showed a high degree of adult plant resistance. It is likely that they carry, in addition to seedling genes which are effective against the strains of rust used in the study, genes for adult plant resistance. The resistance from *timopheevi* should be valuable in breeding for leaf rust resistance since in the present selections *Lr*18 does not seem to be present because *Lr*18 is ineffective against leaf rust virulences both at the adult plant and seedling stages.

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Table 2 *Seedling reactions of timopheevi-derived selections and checks against 11⁺ Indian virulences of leaf rust*

	Physiological virulences										
Selections/checks	11	12	12A-1	20	77	77A-1	77-2	104-A	104-B	104-1	108
67–64–609	0;	0; −1	3	1–2	0;	4	1	0; −1	4	2	2
174–133–671 (Hry)	0; −1	3	4	3	0;	2	1	0; −1	3	0; −1	1–2
134–671–4 (spelt)	0; −1	3	3	1	0;	0;	1	1	0	0; −1	1–2
377–213–725 (Hry)	0; −1	1–2	2	0;	0;	0; −1	0	1–2	0;	1	2
434–227–735 (Hry)	0; −1	1	2	0	2	0; −1	1	0;	1–2	1	3
541–278–772	0;	1	2	0	1–2	0; −1	0; −1	2	0; −1	1–2	2
598–305–780	0; −1	1	4	0;	0;	0; −1	1	0;	0; −1	1–2	3
623–314–782	0; −1	1	2	0;	0;	0;	0; −1	1	0;	0; −1	1–2
643–319–783	0;	1–2	3	0;	0; −1	2	1	2–3	0; −1	1	3
NI 5439	0; −1	4	4	4	0; −1	4	2–3	4	4	4	4
*T. timopheevi**	0	0	0	0	0	0	0	0	0	0	0
*Lr*18**	4	4	4	4	4	–	–	4	–	4	4

* Goel and Sawhney[4]; ** Naqvi[14]; ⁺ Selections and variety NI 5439 were tested against 13 virulences but the data for two races for which the material was susceptible have not been given.

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ANNOUNCEMENTS

THIRD INTERNATIONAL CONFERENCE ON FIBRE REINFORCED COMPOSITES — 1988

The programme will cover developments in new composite materials, fabrication, modelling and applications. Additionally, there will be two sessions on mechanical properties as well as separate coverage of the important areas of impact and environmental performance. Altogether, the three day event will include over 40 papers with contributors from seven countries. The keynote paper, which embodies this theme, will be on "the composite aero engine". Examples of the many topics to be covered are: thermoplastic composites, high temperature resin matrices, SMC injection moulding and materials for HOTOL.

The conference is organized by the UK Plastics and Rubber Institute and is co-sponsored by the Institution of Mechanical Engineers, the Institution of Production Engineers, the Royal Aeronautical Society, the European Polymer Federation and the British Composites Society.

Further information, including full programme and registration forms can be had from Sian Tanner, Plastics and Rubber Institute, 11 Hobart Place, London SW1W OHL.

MIGRAINE—AN UPDATE ON ITS MECHANISMS, MANAGEMENT AND FUTURE THERAPY

(4th/5th May 1988, Royal Society of Medicine, London)

Headache is the most common symptom presenting to primary physicians of which up to 1 in 5 patients suffer from migraine. Despite the prevalence of migraine in the community, the underlying aetiology of this common disorder remains poorly understood. This meeting will attempt to bring together experts with an interest in migraine from a variety of disciplines to provide a unique update on many of the current important areas of clinical and basic research. It will additionally provide an overview on future drug developments for the management of this disease. The meeting should be of value to all health care professionals involved in the management of this disease as well as clinicians and scientists interested in the development of novel strategies for the future therapy of this disease.

For details please contact: Miss Penny Robinson, IBC Technical Services Ltd., Bath House, 56 Holborn Viaduct, London EC1A 2EX.