Table 2. Keratinophilic fungi isolated from different species of animals

Fungi	Cattle	Buffalo	Sheep	Goat	Total
Alternaria sp.	6 (28.57)	2 (22.22)	18 (40.91)	12 (42.86)	38 (37.25)
Aspergillus sp.	1 (4.76)	–	1 (2.27)	1 (3.57)	3 (2.94)
*Beauveria bassiana**	1 (4.76)	–	3 (6.81)	1 (3.57)	5 (4.90)
*Chrysosporium indicum***	–	–	–	1 (3.57)	1 (0.98)
*Chrysosporium keratinophilum***	1 (4.76)	–	–	–	1 (0 98)
*Paecilomyces lilacinous**	–	–	1 (2.27)	1 (3.57)	2 (1.96)
Curvularia sp.	–	–	3 (6 81)	–	3 (2.94)
Penicillium sp.	1 (4.76)	1 (11.11)	1 (2.27)	–	3 (2.94)
*Pseudarachiniotus flavoluteus***	–	–	1 (2.27)	1 (3 57)	2 (2 92)

* Isolates confirmed by CAB International Mycological Institute, UK.
** Isolates confirmed by Calcutta School of Tropical Medicine, Calcutta, India.

reported from skin surfaces of cattle[5]. Similarly cutaneous penicillosis although not reported in cattle, buffaloes and sheep as observed in the present study, species of *Penicillium* have been found to be associated with pathological condition in man[9], camel[10] and birds[11]. *P. flavoluteus* which could be recovered under the present study from sheep and goats thus far appears to be reported from camel[10], hair of rodents[12] and soil[1]. The isolation of these fungi from skin disorder cases in various species of animals suggests their association with the disease processes but its pathogenecity is required to be established experimentally.

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ACKNOWLEDGEMENT. We thank the CAB International Mycological Institute, UK and Calcutta School of Tropical Medicine, Calcutta for confirming the fungal isolates.

Received 19 September 1992, revised accepted 18 February 1993.

Transfer of genes for resistance against stem, leaf and stripe rusts from *Triticum timopheevi* Zhuk to bread wheat

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***Triticum timopheevi* Zhuk is well known to have resistance against a number of important wheat diseases (stem rust, leaf rust, powdery mildew, bunt, loose smut, etc.). Here we report on *timopheevi* derivatives in bread wheat background resistant to stem, leaf and stripe rusts in adult plant stage as well as seedling stage against a number of virulent races of these diseases. Some of them have shown differential reaction than that caused by earlier known genes from *timopheevi* (*Sr36*, *Sr37* and *Lr18*), thereby indicating that these *timopheevi* derivatives may possess different genes.**

TRITICUM TIMOPHEEVI Zhuk is well known to have resistance against a number of wheat diseases (stem rust, leaf rust, powdery mildew, bunt, loose smut, etc.) than any other *Triticum* species[1,2]. In spite of its being a valuable source of resistance against these diseases, it is less exploited. *Sr36* and *Sr37* for stem rust[1,3] *Lr18* for leaf rust[4] and *PM6* for powdery mildew[5,6] are the only known genes from *T. timopheevi*. McIntosh[4] suggested that *Lr18* may not be the only gene for leaf rust resistance in the source line(s) of *T. timopheevi*. Further attempts using high temperature to suppress the action of *Lr18*, or virulent cultures where available, should aid the transfer of such genes. There is so far hardly any

report of transferring gene(s) for resistance against stripe rust from *T. timopheevi*.

T. timopheevi was crossed with bread wheat stocks, such as CM108-31 (a semidwarf mutant of the tall variety C-306) and CM5B (monosomic 5B of CM108-31) using the former as male parent. The pentaploid hybrids ($2n=35$ and $2n-1=34$) were either backcrossed to the bread wheat parent or crossed with another bread wheat variety (Kalyansona) and stock (CM108–33, another semidwarf mutant of C306) for one to three

Table 1. Adult plant reactions of a few *timopheevi* derivatives against stem, leaf and stripe rusts.

Derivatives/ Checks	Crosses	Wellington, 1990		Lahaul, 1990	Pusa, 1990
		Leaf	Stem	Stripe	Leaf
8	(CM5B × timo) × CM108–31	0	0	0	0
12	(CM5B × timo) × CM108–31	0	0	5R	TR
28	(CM108–31 × timo) × CM108–31[2]	0	5MR	50S	10MR
40	(CM108–31 × timo) × CM108–31[2]	0	0	5R	5MR
44	(CM108–31 × timo) × Kalyansona[3]	0	0	5R	0
53	(CM108–31 × timo) × Kalyansona[3]	0	0	0	5MR
65	(CM108–31 × timo) × CM108–31[3]	5R	0	0	TMR
81	(CM108–31 × timo) × CM108–33[3]	0	0	0	TR
CM108–31		40S	40S	30S	80S
CM108–33		40S	40S	30S	80S
Kalyansona		60S	40S	60S	100S
T. timopheevi		0	0	0	0
Lr 18		70XR	50S	30S	100S
SrTt1 (*Sr36*)		10MR	40S	60S	MS
SrTt2 (*Sr37*)		60S	MS	100S	MS

0 = immune; R = resistant, T = trace, M = moderate, S = susceptible, X = mixed reaction.

Table 2. Adult plant reactions of a few *timopheevi* derivatives against stem, leaf and stripe rusts in multilocation test

Derivatives/ Checks	Crosses	Adult plant reactions against					
		leaf rust		stem rust		stripe rust	
		South	North	South	North	South	North
8	(CM5B × timo) × CM108–31	30S (8.5)	0 (0.0)	40MS (6 0)	0	TS	0
12	(CM5B × timo) × CM108–31	40S (13.0)	10S (3.4)	50MS (12.1)	0	TS	0
28	(CM108–31 × timo) × CM108–31[2]	20S (6.4)	5S (3.0)	60S (28.5)	TS	5S	5S
40	(CM108–31 × timo) × CM108–31[2]	20S (5.4)	5S (2.3)	30S (11.0)	0	5S	0
44	(CM108–31 × timo) × Kalyansona[3]	30S (12.2)	5S (1.7)	40MS (8 6)	0	0	0
53	(CM108–31 × timo) × Kalyansona[3]	10MR (1.2)	20MS (6.0)	5S (1.3)	10MS	TS	0
65	(CM108–31 × timo) × CM108–31[3]	20S (5.2)	5S (3.8)	16S (7.35)	5S	TS	0
81	(CM108–31 × timo) × CM108–33[3]	20S (7.7)	10S (5.0)	20S (7.3)	TS	0	0
CM108–31	Checks	60S (32 5)	80S (46 6)	60S (30.5)	40S	0	0
CM108–33	Checks	60S (37.7)	80S (15 2)	60S (32.5)	40S	0	0
Kalyansona	Checks	60S (41.2)	100S (76.6)	80S (60.0)	40S	0	0
T timopheevi	Checks	0	0	0	0	0	0

Coefficient of infection in parenthesis. See Table 1 for explanation.

Table 3. Seedling reactions of a few *timopheevi* derivatives against a few important virulent races of stem, leaf and stripe rusts

Derivatives/ Checks	Races												
	Leaf rust				Stem rust					Stripe rust			
	12A	77–1	104B	107	21A–2	24A	40	40A	117–1	14A	20A	31	38A
8	0;	;1	;	;	2	12	2	12	2	;	;	;n	;
12	0;	x	0;	0;	;	;	;1	12	;	;	;	;	;
28	;12	x	;	;	2	;1	2+	33+	0;	;	;	;	;
40	0;	x	0;	0;	;	;	1	1	0;	0;	;	;	;
44	0;	3+	0;	0;	0;	2	1	2	0;	0;	0;	;	;
53	;1	x	;1	;1	33+	33+	33+c	3+	33+	0;	;	2	3+
65	;1	12+	;	;12	33+	33+	33+	3+	33+	;	0;	;1	0;
81	;1	,1	;	;12	33+	33+	33+	3+	33+	3+	;	;2	;
CM108–31	3+	3+	3+	3+	33+	33+	33+	33+	33+	3+	;	3+	3+
CM108–33	3+	3+	3+	3+	33+	33+	33+	33+	33+	3+	;	3+	3+
Kalyansona	3+	33+	2+3c	;	;	2−	12	33+	33+	3	;	3	3+
T. timopheevi	;	0;	0	;n	;1	−	−	0;	−	2−	−	−	;
SrTt1 (*Sr36*)	−	−	−	−	33+	12	33+	12	;	−	−	−	−
SrTt2 (*Sr37*)	−	−	−	−	12	12	1	12+	33+	−	−	−	−
Lr 18	4	4	4	4									

Infection types: 0;, ;, 1, 2⁻, 2, 2⁺ = resistance of different degree, n = necrosis, c = chlorosis; 3, 3⁺, 4 = susceptible.

generations till the fertility was restored. This was followed by repeated selfing and screening against stem, leaf and stripe rusts, starting from F_4 up to eight or more generations till homozygosity in morphological characters as well as diseases reactions was attained. Screening for rusts resistance in adult plant stage was made in three different locations, Delhi (in epiphytotic conditions), Lahaul (hot spot for stripe rust) and Wellington (hot spot for stem and leaf rusts). Seedling reaction against important virulent races of stem, leaf and stripe rusts was conducted at Flowerdale, Shimla.

A number of *timopheevi* derivatives showing immune, resistant or tolerant reactions against all the three rusts in adult plant stage have been identified (Table 1). These lines have been stabilized for morphological characters, fertility and diseases reaction.

A set of 21 of these stable lines was subjected to multilocation test in a disease nursery (IRSN, Initial Rust Screening Nursery) conducted by Wheat Project Directorate, New Delhi, 1989. A number of them have shown resistance or tolerance against stem, leaf and stripe rusts both in South and in North India and a few either in the North or in the South (Table 2).

Seedling reactions test against a few important virulent races of stem, leaf and stripe rusts was first conducted with F_5 plant progenies. Test was again repeated with stabilized *timopheevi* derivatives. These lines have not only shown high degree of resistance against these virulent races but also some of them have shown differential reaction compared to that observed on earlier reported genes from *timopheevi* (*Sr36*, *Sr37* and *Lr18*), thereby indicating that these derived lines may possess different genes (Table 3). These new sources of resistance against all the three rust diseases of wheat, that have ever been developed from an alien source, should prove useful to the wheat breeders as donor stocks for broadening the genetic base of resistance against rusts.

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ACKNOWLEDGEMENTS. We thank J. P. Tandon, Project Director, Wheat, for screening the materials in the 'Initial Rust Screening Nursery', and M. Prashar for helping in seedling test.

Received 18 February 1993; accepted 22 March 1993