

UKCPVS 2011 ANNUAL REPORT

BROWN RUST OF WHEAT

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Virulence for *Lr24* and for the cultivars Stigg and Warrior was detected for the first time in isolates from the 2011 season. Virulence for Robigus, first identified in 2006, reached a frequency of 50%.

INTRODUCTION

There was a moderate incidence of brown rust in wheat in 2011.

2011 ISOLATES: SEEDLING VIRULENCE TESTS

METHODS

21 isolates were tested from 11 different wheat cultivars (Table 1). Three of these came from Stigg, a cultivar which had previously been resistant at seedling and adult plant stages and was rated as 9 for resistance on the HGCA Recommended List. The greatest number of isolates came from Lincolnshire (Table 2.)

Table 1. Cultivars from which brown rust isolates were tested

Cultivar	1-9* rating	No. isolates tested
Stigg	9	3
Scout	9	2
Warrior	8	4
Viscount	8	2
Gravitas	7	2
Horatio	6	1
Monterey	6	1
Invicta	7	1
Oakley	7	1
Alchemy	5	2
Glasgow	4	2
TOTAL		21

*HGCA Recommended List for 2012/2013

Table 2. Locations from which brown rust isolates were tested

Region	County	No. of isolates tested
East Anglia	Cambridgeshire	3
	Essex	4
East Midlands	Lincolnshire	13
South East	Kent	1
TOTAL		21

METHODS

Isolates were tested for virulence on seedlings of three sets of wheat lines: 1) the standard WBR differential cultivars, 2) selected ‘Thatcher’ Near Isogenic Lines (NILS) carrying different *Lr* resistance genes, and 3) current UK cultivars with known or unknown resistance genes (Table 3).

Table 3. Differential cultivars used in 2011 seedling virulence tests

Differential cultivar	WBR factor	<i>Lr</i> gene
<u>Standard WBR cultivars</u>		
Clement	WBR 1	<i>Lr26</i>
Fundin	WBR 2	<i>Lr17b</i>
Sappo	WBR 3	<i>Lr20</i>
Halberd	WBR 4	<i>Lr20</i>
Sterna	WBR 7	<i>Lr3a</i>
Armada	WBR 0	
<u>Thatcher near isogenic lines</u>		
Tc*6/Centenario		<i>Lr1</i>
Tc*6/ST-1.25		<i>Lr26</i>
Tc*8/VPM1		<i>Lr37</i>
<u>Additional cultivars</u>		
Alchemy	‘Claire’	
Glasgow		<i>Lr1</i>
Robigus	‘Rob’	
Scout	? ‘Rob’	
Horatio	?	
Gravitas		
Invicta		
Timber	R	<i>Lr24</i>
Stigg	R	
Warrior	R	

RESULTS

Seedling virulence frequencies are shown in Table 4.

The most significant development in 2011 was the detection, for the first time, of virulence for Timber (*Lr24*) and for Stigg. Isolates virulent on Stigg tended also to be virulent on Timber, indicating that Stigg may carry the *Lr24* resistance. Virulence was also detected for the first time for Warrior, another proposed *Lr24* cultivar.. However, the relationship between virulence for Warrior, Stigg and *Lr24* and for the other two cultivars showed some inconsistency and requires further investigation.

Virulence for Robigus was detected again, in about half of the 2011 isolates, after its absence from isolates tested in 2010.

Table 4. Virulence frequencies 2002 - 2011

		02	03	05	06	07	08	09	10	11
<u>WBR cvs</u>										
Clement	WBR 1	84	73	69	44	21	24	0	70	5
Fundin	WBR 2	56	73	100	100	100	86	91	70	86
Sappo	WBR 3	0	0	13	28	8	5	0	0	14
Halberd	WBR 4	0	0	13	24	8	10	9	0	10
Sterna	WBR 7	50	68	56	68	8	14	0	90	0
Armada	WBR 0	100	100	100	100	100	100	100	100	100
<u>Thatcher NILs</u>										
Tc*6/Centenario	<i>Lr1</i>	0	0	28	32	13	14	18	0	10
Tc*6/ST-1.25	<i>Lr26</i>	73	73	69	44	17	33	0	40	5
Tc*8/VPM1	<i>Lr37</i>				100	30	91	27	100	91
<u>Additional cultivars</u>										
Alchemy	R 'Claire'				100	58	100	100	100	91
Glasgow	<i>Lr1</i>				32	17	19	18	0	10
Robigus	'Rob'				32	30	10	18	0	52
Scout	? 'Rob'						14	18	0	43
Horatio										38
Gravitas										57
Invicta										57
Timber	R (<i>Lr24</i>)					0	0	0	0	19
Stigg	?									24
Warrior	?								0	5
No. of isolates tested		14	22	32	25	24	21	11	10	21

2010 ISOLATES: ADULT PLANT TESTS

METHODS

Three isolates from the 2010 survey (Table 5) were tested on a set of 50 cultivars in adult plant tests in field isolation nurseries. Seedling tests of the same isolates and cultivars were carried out under standard controlled environment conditions.

Table 5. Isolates tested on adult plants in 2011 (virulence for resistances of overall type detectable at the seedling stage).

Code	Cultivar	Location	Virulent on
10/1	Brentano	Kent	-
10/2	Warrior	Cambridgeshire	R1, R7
10/9	Scout	Cambridgeshire	R1, R7, <i>Lr26</i>

RESULTS AND DISCUSSION

The results of adult plant tests are given in Table 6, with corresponding seedling reactions in Table 7.

Adult plant results in Table 6 are mean leaf area infection values for six assessments made at approximately 7-day intervals between GS 57 and GS 85 (25 May – 28 June).

All three isolates were avirulent on adult plants of cultivars believed to carry the ‘Robigus’ resistance or the *Lr1* resistance, in line with expectations from seedling reactions. The only anomalous result was the appearance of low levels of infection on Robigus itself with isolate WBR 10/1. The most likely explanation is contamination by naturally occurring brown rust. The isolates were also avirulent on cultivars carrying the ‘Claire’ adult plant resistance, although virulence for this resistance has been common in recent years.

Isolates 10/2 and 10/9 proved to be avirulent on the cultivars from which they had reputedly been collected (Warrior and Scout respectively). *Lr24* maintained its effectiveness against the 2010 isolates at both seedling and adult plant stages.

Table 6. Adult Plant Tests: % leaf area infected with brown rust (mean of 6 assessments)

Cultivar	R Factors	WBR10/1	WBR10/2	WBR10/9
Robigus	Robigus	5.5	0.0	0.2
Oakley	Robigus	0.0	0.0	0.0
Scout	Robigus	0.0	0.0	0.0
Viscount	Robigus	0.0	0.0	0.0
Gravitas	Robigus	0.0	0.1	0.0
Invicta	Robigus	0.3	0.0	0.0
KWS Target	? Robigus	1.1	0.0	0.0
Glasgow	<i>Lr1</i>	0.1	0.1	0.1
Denman	? <i>Lr1</i>	0.0	0.0	0.0
KWS Podium	?	0.1	0.0	0.0
Warrior	<i>Lr24?</i>	0.0	0.0	0.0
Stigg	<i>Lr24</i>	0.0	0.0	0.0
Timber	<i>Lr24</i>	0.2	0.0	0.0
Claire	Claire (APR)	0.2	0.0	0.1
Alchemy	Claire (APR)	0.0	0.0	0.0
Beluga	Claire (APR)	0.2	0.0	0.2
Cassius	?Claire (APR)	0.0	0.0	0.0
KWS Sterling	?APR	0.0	0.0	0.0
Cocoon	?APR	0.0	0.0	0.0
Tuxedo	?APR	0.1	0.1	0.3
Maris Ranger	WBR8 (APR)	0.2	0.1	0.2
Panorama	?	1.1	0.6	0.2
Kingdom	?	0.3	2.0	0.3
Einstein	<i>Lr10</i>	1.8	2.1	1.2
Duxford	?	1.4	3.2	0.7
Sterna	<i>Lr3a</i>	2.7	2.7	2.3
Conqueror	?	1.3	2.6	5.1
Savannah	<i>Lr26,Lr37</i>	3.0	1.3	6.9
Solstice	<i>Lr13</i>	2.2	4.0	6.6
Napier	<i>Lr26,Lr37</i>	2.3	4.2	7.8
Gallant	?	1.9	8.2	5.9
JB Diego	?	6.0	10.8	4.9
KWS Santiago	?	4.8	13.3	10.0
Reaper	<i>Lr37</i>	9.4	10.5	9.3
Mascot	<i>Lr37</i>	9.3	11.8	12.2
Gamin	WBR6	11.2	10.2	13.7
Hereford	?	11.8	15.3	11.5
Brigadier	<i>Lr26,Lr37</i>	7.2	12.7	19.3

Table 6. contd

Cultivar	R Factors	WBR10/1	WBR10/2	WBR10/9
Armada	0	8.0	19.5	13.8
Clement	<i>Lr26</i>	16.7	29.7	11.8
Maris Huntsman	<i>Lr13</i>	27.2	30.5	18.8
Consort	<i>Lr10,Lr13</i>	19.3	27.8	37.5
Slejpner	<i>Lr26</i>	31.7	32.0	24.2
Grafton	?	35.3	25.2	27.8
Soissons	<i>Lr14a</i>	17.2	28.3	43.7
Tanker	<i>Lr26</i>	25.0	39.3	33.3
Cordiale	?	33.0	17.8	48.3
Buster	?	40.5	42.0	23.3
Avalon	WBR9 (APR)	37.2	46.7	36.2
Maris Fundin	WBR2 (APR)	43.3	51.7	27.5

Table 7 Seedling reactions to 3 isolates tested in adult plant tests (AIT = Average Infection Type, 0-4)

Cultivar	R Factors	WBR10/1	WBR10/2	WBR10/9
Robigus	Robigus	0.0	0.0	0.0
Oakley	Robigus	0.0	0.0	0.0
Scout	Robigus	0.0	0.0	0.0
Viscount	Robigus	0.0	0.0	0.0
Gravitas	Robigus	0.0	0.0	0.0
Invicta	Robigus	0.0	0.0	0.0
KWS Target	? Robigus	0.1	0.0	0.0
Glasgow	<i>Lr1</i>	0.0	0.0	0.0
Denman	? <i>Lr1</i>	0.0	0.0	0.0
KWS Podium	?	0.0	0.0	0.0
Warrior	<i>Lr24</i>	0.0	0.4	0.0
Stigg	<i>Lr24</i>	0.0	0.3	0.0
Timber	<i>Lr24</i>	0.0	0.6	0.2
Claire	Claire (APR)	4.0	3.0	3.0
Alchemy	Claire (APR)	4.0	3.3	4.0
Beluga	Claire (APR)	4.0	3.0	3.0
Cassius	?Claire (APR)	4.0	3.5	4.0
KWS Sterling	?APR	4.0	3.0	3.0
Cocoon	?APR	3.8	3.3	4.0
Tuxedo	?APR	4.0	3.0	3.6
Maris Ranger	WBR8 (APR)	3.0	2.7	2.5
Panorama	?	3.8	3.0	3.0
Kingdom	?	3.6	2.5	2.5
Einstein	<i>Lr10</i>	4.0	3.0	3.7
Duxford	?	4.0	3.4	2.7
Sterna	<i>Lr3a</i>	3.6	4.0	4.0
Conqueror	?	3.7	3.0	3.0
Savannah	<i>Lr26,Lr37</i>	2.6	3.4	3.0
Solstice	<i>Lr13</i>	4.0	2.6	4.0
Napier	<i>Lr26,Lr37</i>	3.0	2.6	3.4
Gallant	?	3.7	3.0	4.0
JB Diego	?	*	*	*
KWS Santiago	?	4.0	3.0	3.0
Reaper	<i>Lr37</i>	3.0	3.3	3.0
Mascot	<i>Lr37</i>	3.4	3.0	3.0
Gamin	WBR6	4.0	3.4	4.0
Hereford	?	4.0	3.3	4.0
Brigadier	<i>Lr26,Lr37</i>	2.4	3.0	0.0

Table 7 contd

Cultivar	R Factors	WBR10/1	WBR10/2	WBR10/9
Armada	0	4.0	4.0	4.0
Clement	<i>Lr26</i>	4.0	4.0	4.0
Maris Huntsman	WBR5	4.0	3.7	3.5
Consort	<i>Lr10,Lr13</i>	4.0	3.0	4.0
Slejpner	<i>Lr26</i>	3.0	3.0	0.0
Grafton	?	3.0	2.8	3.5
Soissons	<i>Lr14a</i>	3.0	3.3	2.6
Tanker	<i>Lr26</i>	3.0	3.0	3.0
Cordiale	?	4.0	3.0	3.0
Buster	?	3.0	3.0	3.0
Avalon	WBR9 (APR)	3.3	3.0	3.0
Maris Fundin	WBR2 (APR)	3.5	4.0	3.0

Susceptible (AIT 2.8 - 4.0)
 Intermediate (AIT 2.0 - 2.7)
 Resistant (AIT 0.0 - 1.9)

* = not tested

UKCPVS 2011 ANNUAL REPORT

YELLOW RUST OF WHEAT

A J HUBBARD and R A BAYLES

Virulence for Warrior was identified for the first time and was confirmed in seedling virulence tests of more than half the isolates collected and tested in 2011. There were substantial increases in virulence for *Yr7* and for the varieties Timber and Cadenza.

INTRODUCTION

Yellow rust was widespread in farm crops and variety trials in 2011 and this was reflected in the above average number of samples received by the UKCPVS.

2011 ISOLATES: SEEDLING VIRULENCE TESTS

METHODS

27 isolates were selected for virulence testing on the basis of the cultivar and location from which samples had been collected.

Isolates tested came from 16 different wheat cultivars (Table 1). Eight isolates were from highly resistant cultivars with the highest rating of 9 on the HGCA Recommended List. A further 13 were from varieties with ratings of 8 and included six from the variety Warrior.

The large majority of isolates came from the high risk eastern counties of England, predominantly Lincolnshire and Cambridgeshire.

Virulence tests were carried out on seedlings of the differential cultivars listed in Table 3, using the methods described by Priestley, Bayles and Thomas, 1984. Additional cultivars, of particular relevance to UK breeding, were added to the core differential set.

Table 1. Cultivars from which wheat yellow rust isolates were tested

Cultivar	1-9 Resistance rating*	No. of isolates tested
Beluga	9	1
Claire	9	1
Crusoe	9	2
KWS Sterling	9	1
Panorama	9	1
Stigg	9	2
Alchemy	8	1
Cocoon	8	2
Horatio	8	1
Invicta	8	2
SY Epsom	8	1
Warrior	8	6
Chilton	7	1
Denman	7	1
Gravitas	7	2
Torch	4	2
TOTAL		27

*HGCA Recommended List 2012/13, or RL trials 2011.

Table 2. Locations from which wheat yellow rust isolates were tested

Region	County	No. of isolates tested
East Anglia	Cambridgeshire	6
	Suffolk	1
East Midlands	Leicestershire	3
	Lincolnshire	10
	Northamptonshire	1
West Midlands	Oxfordshire	1
South East	Kent	2
	Hampshire	1
Scotland	East Lothian	2
TOTAL		27

Table 3. Differential cultivars used in 2011 seedling virulence tests

Differential cultivar	WYR factor	Gene designation
<u>Core set</u>		
Chinese 166	WYR1	<i>Yr1</i>
Kalyansona	WYR2	<i>Yr2</i>
Vilmorin 23	WYR3	<i>Yr3+</i>
Nord Desprez	WYR3	<i>Yr3+</i>
Hybrid 46	WYR4	<i>Yr4</i>
Heines Kolben	WYR2,6	<i>Yr2, Yr6</i>
Heines Peko	WYR2,6	<i>Yr2, Yr6</i>
Lee	WYR7	<i>Yr7</i>
Brock	WYR7	<i>Yr7</i>
Compair	WYR8	<i>Yr8</i>
Kavkaz x 4 Fed	WYR9	<i>Yr9</i>
Clement	WYR9	<i>Yr9</i>
AVS xYr15	WYR15	<i>Yr15</i>
VPM 1	WYR17	<i>Yr17</i>
Rendezvous	WYR17	<i>Yr17</i>
Carstens V	WYR32	<i>Yr32</i>
Talon	WYR32	<i>Yr32</i>
<u>Additional cultivars*</u>		
Robigus	WYR 'Rob'	
Solstice (4)	WYR 'Sol'	
Timber	WYR 'Tim'	
Cadenza	WYR6,7+APR	
Alchemy (8)		
Beluga (9)		
Chilton (7)		
Claire (9)		
Cocoon (8)		
Crusoe (9)		
Denman (7)		
Gravitas (7)		
Horatio (8)		
Invicta (8)		
KWS Solo (9)		
KWS Sterling (9)		
Panorama (9)		
Scout (9)		
Stigg (9)		
SY Epson (8)		
Tuxedo (9)		
Warrior (8)		

* with resistance ratings in brackets for cultivars on HGCA RL for 2012/13 or grown in RL trials 2011

RESULTS AND DISCUSSION

Virulence frequency data for 2011, together with data from 2001-2010, are shown in Table 4.

Table 4. Virulence frequencies (%) from 2001 to 2011

Virulence for	01	02	03	04	05	06	07	08	09	10	11
WYR 1	100	97	100	100	100			100	100	100	100
WYR 2	100	97	100	100	100			100	100	100	100
WYR 3	100	97	100	93	100			91	99	100	100
WYR 4	74	63	86	50	87	100	100	81	98	100	100
WYR 6	39	31	50	42	10	19	4	19	90	98	95
WYR 7	0	3	36	4	8	11	4	0	0	24	65
WYR 8	0	0	0	0	0	0	0	0	0	0	0
WYR 9	90	88	93	100	95	100	94	93	93	99	98
WYR 15	0	0	0	0	0	0	0	0	0	0	0
WYR 17	77	88	93	85	97	100	88	83	87	97	96
WYR 32	42	73	64	38	85	89	92	79	94	95	98
Robigus 'Rob'				31	79	89	84	81	81	100	100
Solstice 'Sol'								10	69	98	96
Timber 'Tim'						7	0	5	2	0	48
Cadenza R6,7+?										*3	48
Alchemy (8)									14	70	85
Beluga (9)										70	96
Chilton (7)											96
Claire (9)					23	0	4	14	43	83	93
Cocoon (8)										85	96
Crusoe (9)											0
Denman (7)										100	100
Gravitas (7)											63
Horatio (8)											100
Invicta (8)										95	96
KWS Solo (9)											48
KWS Sterling (9)											7
Panorama (9)										65	81
Scout (9)											67
Stigg (9)											0
SY Epson (8)											41
Tuxedo (9)										53	56
Warrior (8)										**3	52
No. of isolates	31	36	14	48	39	27	25	21	42	40	27

** late development of restricted susceptible reactions

* not confirmed in further tests in 2011

Virulence for Warrior was definitely confirmed for the first time. Prior to 2011, susceptible reactions had occasionally been observed on Warrior, but these tended to be sparse and slower to develop than on other varieties. More than 50% of isolates in 2011 were virulent on Warrior and there were parallel increases in virulence for *Yr7*, Timber and Cadenza. The most common pathotype recorded was virulent on *Yr1,2,3,4,6,7,9,17,32* together with Robigus, Solstice, Timber, Warrior and Cadenza.

Two varieties, Crusoe and Stigg, remained resistant to all isolates. Two isolates were virulent on KWS-Sterling.

2010 ISOLATES: ADULT PLANT TESTS

METHODS

Eight isolates (Table 5) were tested on a set of 39 cultivars in adult plant tests in field isolation nurseries. Seedling tests of the same isolates and cultivars were carried out under standard controlled environment conditions.

Table 5. Isolates tested on adult plants in 2011

Code	Year	Location	Cultivar	Virulence at seedling stage
10/43	2010	Lincolnshire	Edmunds	1,2,3,4,6,9,17,32,Rob,Sol
10/53	2010	Lincolnshire	Denman	1,2,3,4,6,9,17,32,Rob,Sol
10/64	2010	Cambridgeshire	Claire	1,2,3,4,6,9,17,32,Rob,Sol
10/74	2010	Bedfordshire	Alchemy	1,2,3,4,6,(7),9,17,32,Rob,Sol
10/77	2010	Bedfordshire	Warrior	1,2,3,4,6,9,17,32,Rob,Sol
10/82	2010	Cambridgeshire	Alchemy	1,2,3,4,6,9,17,32,Rob,Sol
10/84	2010	Lincolnshire	Warrior	1,2,3,4,6,9,17,32,Rob,Sol
10/517	2010	Cambridgeshire	Cocoon	1,2,3,4,6,9,17,32,Rob,Sol

RESULTS AND DISCUSSION

The results of adult plant tests are presented in Table 6, with corresponding seedling reactions in Table 7. In Table 6, percentage infection levels are expressed as the mean of eight assessments made at weekly intervals between 4 May (GS36) and 23 June (GS 72).

Adult plant reactions were very similar to all eight isolates, despite a few hints of variety x isolate interactions at the seedling stage.

The two isolates made from samples collected from Warrior, 10/77 and 10/84, both failed to produce infection on adult plants of Warrior, although 10/77 did show a slightly increased infection type (2.1) in seedling tests.

A few varieties were resistant at both seedling and adult plant stages e.g KWS-Sterling, Stigg. There were also examples of varieties which were susceptible at the seedling stage, but resistant as adult plants e.g. Claire, Beluga, Cassius.

Many varieties however were susceptible to all isolates at both seedling and adult plant stages, but possessed contrasting levels of background / partial resistance – as shown by the wide range of infection levels developing on different varieties.

Table 6. Adult Plant Tests. % leaf area infected with yellow rust (mean 8 assessments)

Variety	R Factors	10/77	10/84	10/43	10/53	10/517	10/74	10/82	10/64
KWS Sterling	?	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Scout	x+APR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stigg	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cadenza	6,7+APR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grafton	7	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1
Claire	x+APR	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Beluga	x+APR	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Warrior	?	0.1	0.0	0.1	0.0	0.3	0.0	0.0	0.0
Cordiale	7	0.0	0.0	0.2	0.0	0.0	0.1	0.0	0.2
KWS Target	x+APR	0.2	0.0	0.2	0.0	0.2	0.0	0.1	0.2
Cassius	x+APR	0.1	0.2	0.1	0.2	0.0	0.0	0.0	0.2
Brock	7,14	0.1	0.1	0.1	0.3	0.0	0.3	0.0	0.2
Alchemy	x+APR	0.1	0.2	0.1	0.0	0.2	0.2	0.1	0.2
Panorama	Sol+?	0.1	0.1	0.0	0.7	0.1	0.1	0.2	0.2
JB Diego	?	1.3	0.9	1.0	0.2	0.5	0.0	0.0	0.2
Gravitas	x+APR	0.5	0.2	0.8	0.2	1.9	0.6	0.5	0.7
Timber	Tim	0.1	0.0	0.0	3.7	0.2	0.2	1.2	1.0
Invicta	x+APR	0.6	0.7	2.6	1.1	0.2	1.6	0.3	3.5
Maris Huntsman	13	1.2	1.2	1.0	2.1	0.6	1.8	1.3	3.0
Kingdom	?	2.4	1.3	1.5	1.3	1.5	1.4	1.7	2.2
Denman	?	2.1	0.4	1.5	2.9	1.9	1.1	0.6	3.2
Cocoon	x+APR	2.8	2.2	2.4	0.4	3.4	4.3	2.6	3.2
Gallant	?	4.8	3.1	1.1	1.4	4.1	4.0	3.5	4.8
Duxford	6+	2.7	1.5	4.7	4.2	4.2	4.5	1.1	4.2
Einstein	6+	6.2	7.0	2.1	6.5	5.6	7.2	10.4	4.5
Talon	32	7.0	7.1	5.3	8.9	9.9	11.6	9.8	9.3
KWS Podium	Rob	10.4	7.7	7.9	9.0	9.4	10.2	10.3	9.9
Conqueror	?	11.8	8.0	9.8	4.6	11.8	11.9	12.9	14.6
Hobbit	14	7.3	9.1	10.8	9.8	11.8	11.6	11.1	14.2
KWS Santiago	?	9.9	4.8	10.0	10.2	10.4	12.6	15.6	13.8
Mascot	6,17	11.7	11.1	7.1	11.9	10.9	17.6	13.8	13.8
Napier	6,9,17	12.1	8.9	15.0	14.1	10.3	13.6	9.6	18.2
Solstice	Sol	14.4	20.9	10.7	12.9	16.9	19.6	22.5	22.3
Hornet	6,9	23.7	24.8	28.5	34.3	18.0	29.3	20.4	38.4
Viscount	Sol	28.3	27.4	23.3	33.8	27.6	25.8	27.4	28.6
Slejpner	9	37.6	38.8	23.9	31.6	31.9	45.4	39.1	40.8
Robigus	Rob	46.8	33.2	45.1	44.9	23.6	43.0	35.8	40.0
Brigadier	9,17	47.2	28.7	44.4	40.1	42.6	52.8	24.9	37.1
Oakley	6+?	51.8	29.3	50.6	49.4	44.3	38.1	43.0	49.8

Table 7. Seedling reactions to 8 isolates tested in adult plant tests (AIT = Average Infection Type)

Variety	R Factors	10/77	10/84	10/43	10/53	10/517	10/74	10/82	10/64
KWS Sterling	?	0.4	0.0	0.2	0.8	0.0	0.7	0.1	0.0
Scout	x+APR	1.6	2.2	2.6	1.7	0.4	2.2	1.1	0.9
Stigg	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cadenza	6,7+APR	1.3	0.0	0.0	2.0	0.0	0.7	0.0	0.0
Grafton	7	1.2	0.2	0.5	2.3	0.2	1.5	0.0	0.2
Claire	x+APR	2.4	3.0	3.1	2.9	3.0	3.0	3.0	2.5
Beluga	x+APR	2.9	2.7	3.2	3.0	3.0	3.0	3.0	2.1
Warrior	?	2.1	0.4	1.3	0.9	1.8	0.7	1.0	0.4
Cordiale	7	0.5	0.3	0.2	2.2	0.0	1.6	0.0	0.1
KWS Target	x+APR	2.9	1.8	2.5	1.5	2.2	3.0	2.9	3.0
Cassius	x+APR	1.9	3.0	2.2	3.0	3.0	2.9	2.8	3.0
Brock	7,14	0.8	0.7	0.8	0.0	0.1	2.0	0.2	0.2
Alchemy	x+APR	2.4	2.6	2.8	2.7	3.0	2.4	2.0	2.6
Panorama	Sol+?	3.0	3.2	3.0	3.3	2.5	3.0	3.0	3.2
JB Diego	?	2.0	1.6	2.3	1.0	0.3	0.3	1.6	2.4
Gravitas	x+APR	2.2	3.0	2.0	1.7	2.3	2.5	2.2	1.0
Timber	Tim	0.2	0.4	0.2	0.0	2.2	1.8	0.9	0.3
Invicta	x+APR	3.0	3.0	3.0	3.0	2.4	3.0	3.2	4.0
M. Huntsman	13	Not tested							
Kingdom	?	4.0	3.0	3.0	3.0	4.0	3.0	4.0	4.0
Denman	?	3.3	3.2	3.2	3.1	4.0	4.0	3.0	3.0
Cocoon	x+APR	3.0	3.5	3.1	3.0	2.8	3.0	3.0	3.2
Gallant	?	3.5	3.0	3.0	3.2	3.5	3.4	3.0	4.0
Duxford	6+	2.6	3.0	3.1	2.6	3.0	3.0	3.0	3.0
Einstein	6+	3.4	4.0	3.0	3.2	3.2	3.0	4.0	4.0
Talon	32	4.0	3.1	3.0	3.0	3.0	4.0	4.0	4.0
KWS Podium	Rob	4.0	4.0	4.0	3.0	3.5	4.0	3.0	4.0
Conqueror	?	4.0	3.5	4.0	3.0	4.0	3.5	4.0	3.4
Hobbit	14	Not tested							
KWS Santiago	?	3.0	3.0	4.0	3.4	4.0	4.0	3.5	4.0
Mascot	6,17	4.0	3.1	4.0	3.0	4.0	3.2	3.1	4.0
Napier	6,9,17	3.5	3.2	4.0	3.2	3.5	3.1	3.1	4.0
Solstice	Sol	4.0	4.0	4.0	3.0	1.6	3.3	3.0	4.0
Hornet	6,9	3.2	4.0	3.3	3.0	4.0	3.1	4.0	4.0
Viscount	Sol	3.0	4.0	3.0	3.0	3.0	3.0	3.0	3.0
Slejpner	9	3.0	3.2	3.0	3.1	4.0	3.0	4.0	3.0
Robigus	Rob	3.5	3.2	4.0	3.0	2.6	4.0	3.5	4.0
Brigadier	9,17	4.0	3.0	3.0	3.0	3.0	3.0	3.0	3.1
Oakley	6+?	3.0	3.0	4.0	2.7	3.2	3.0	3.5	4.0

Susceptible (AIT 2.8 - 4.0)
 Intermediate (AIT 2.0 - 2.7)
 Resistant (AIT 0.0 - 1.9)

REFERENCE

Priestley R H, Bayles R A and Thomas J E (1984). Identification of specific resistances against *Puccinia striiformis* (Yellow Rust) in winter wheat varieties. 1. Establishment of a set of type varieties for adult plant tests. *Journal of the National Institute of Agricultural Botany*, **16**, 469-476.