Table 1. **List of markers and PCR conditions, used to identify resistance genes to brown and stem rust**

Gene	Localization	Gene source	Molecular marker			Size of PCR product, bp	Reference
			name	Nucleotide sequence	PCR conditions		
Lr9	6BL	*Aegilops umbellulata*	J13/1-F J13/2-R	5´TCCTTTTATTCCGCACGCCGG 5´CCACACTACCCCAAAGAGACG	94 ^{0}C – 6 min, 45 cycles (92 ^{0}C – 1 min, 60 ^{0}C – 1 min, 72 ^{0}C – 2 min), 72 ^{0}C – 10 min	1100	Schachermayer et al., 1994 [11]
			SCS5-F SCS5-R	5´TGCGCCCTTCAA AGGAAG 5´TGCGCCCTTCTG AACTGTAT	94 ^{0}C – 2 min, 30 cycles (94 ^{0}C – 1 min, 64 ^{0}C – 1 min, 72 ^{0}C – 1 min), 72 ^{0}C – 4 min	550	Gupta et al.,2005 [12]
Lr28	4AL	*Aegilops speltoides*	Lr28-01 Lr28-02	5CCCGGCATAAGTCTATGGTT 5´CAATGAATGAGATACGTGAA	94 ^{0}C – 6 min, 35 cycles (94 ^{0}C – 1 min, 55 ^{0}C – 1 min, 72 ^{0}C – 1 min), 72 ^{0}C – 5 min	378	Naik et al., 1998 [13]
			SCS421-F SCS421-R	5´ACAAGGTAAGTC TCCAACCA 5´AGTCGACCGAGA TTTTAACC	94 ^{0}C – 3 min, 35 cycles (94 ^{0}C – 1 min, 57 ^{0}C – 1 min, 72 ^{0}C – 1 min), 72 ^{0}C – 5 min	570	Cherukuri et al., 2005 [14]
Lr35/Sr39	2BL	*Aegilops speltoides*	Sr39#22rF Sr39#22rR	5´AGAGAAGATAAGCAGTAAACATG 5´TGCTGTCATGAGAGGAACTCTG3´	94 ^{0}C – 5 min, 30 cycles (92 ^{0}C – 30 s, 58 ^{0}C – 30 s, 72 ^{0}C – 40 s), 72 ^{0}C – 5 min	817	Mago et al., 2009 [15]
			Sr39#50s-F Sr39#50s-R	5´CCAATGAGGAGATCAAAACAACC 5´TAGCAAGGACCAAGCAATCTTG	94 ^{0}C – 3 min, (94 ^{0}C – 30 s, 65 ^{0}C – 30 s, 72 ^{0}C – 40 s) 7 cycles with the decrease by 1 ^{0}C, 30 cycles (94 ^{0}C – 30 s, 58 ^{0}C – 30 s, 72 ^{0}C – 40 s),72 ^{0}C – 5 min	250/285	Mago et al., 2009 [15]
			BE500705F BE500705R	5´ATCTGTGGCAGTGTGCTCCT3´ 5´TCCTGCAAATGCTTGTCGTT3´	94 ^{0}C – 3 min, 30 cycles (92 ^{0}C – 30 s, 56 ^{0}C – 30 s, 72 ^{0}C – 40 s), 72 ^{0}C – 5 min	290	Mago et al., 2009 [15]
			Sr39F2 Sr39R3	5´AGAGAGAGTAGAAGAGCTGC3´ 5´AGAGAGAGAGCATCCACC3´	94 ^{0}C – 3 min, 35 cycles (94 ^{0}C – 30 s, 60 ^{0}C – 1 min, 72 ^{0}C – 2 min), 72 ^{0}C – 10 min	900	Gold et al., 2002 [16]
Sr2	3BS	*Triticum turgidum*	GWM 533F GWM533R	5´GTTGCTTTAGGGGAAAAGCC3´ 5´AAGGCGAATCAAACGGAATA3´	94 ^{0}C – 3 min, 40 cycles (94 ^{0}C – 30 s, 62 ^{0}C – 30 s, 72 ^{0}C – 30 s), 72 ^{0}C – 2 min	120	Hayden et al., 2004 [17]
			csSr2-F csSr2-R	5´CAAGGGTTGCTAGGATTGGAAAAC3´ 5´AGATAACTCTTA TGATCTTACATTTTTCTG3´	94 ^{0}C – 2 min, 30 cycles (94 ^{0}C – 30 s, 60 ^{0}C – 40 s, 72 ^{0}C – 50 s), 72 ^{0}C – 5 min, 4 ^{0}C – 5 min	172	Mago, R et al., 2011 [18]

Sr22	7AL	*Triticum monococcum*	CFA2019F CFA2019R	5´GACGAGCTAACTGCAGACCC3´ 5´CTCAATCCTGATGCGGAGAT3´	94 ^{0}C – 3 min, 35 cycles (94 ^{0}C – 45 s, 60 ^{0}C – 5 s, 72 ^{0}C – 30 s), 72 ^{0}C – 4 min	200-/235+	Khan et al,2005 [19]
			BARC121-F BARC121-R	5'ACTGATCAGCAATGTCAACTGAA3´ 5'CCGGTGTCTTTCCTAACGCTATG3´	94 ^{0}C – 3 min, 35 cycles (94 ^{0}C – 45 s, 50 ^{0}C – 45 s, 72 ^{0}C – 60 s), 72 ^{0}C – 4 min	215+/230-	Yu et.al.,2010 [20]

Table 2. **The results of phytopathological evaluation and PCR-analysis of the collection of spring triticale by its resistance to brown and stem rust**

No of catalogue	Name	Damage degree, type of response in terms of resistance to stem rust	***Sr2***		***Sr22***		Damage degree, type of response in terms of resistance to brown rust	***Lr9***		***Lr28***		***Lr35/Sr39***			
			Gwm533 (120 bp)	CsSr2 (172, 11253 bp)	*BARC121* (215 bp) (197, 215 bp)*	*CFA2019* (235 bp)		*J13* (1100 bp)	SCS5 (550 bp)	*Lr28-01* (378 bp)	SCS421 (570 bp)	*Sr39#22r* (817 bp)	*Sr39#50s* (250 bp, 285 bp)	*Sr39 (900 bp)*	BE500705 (290 bp)*
3886	Dahbi /3/ Fahad 8-2*2// PTP	0R	-	-	+	-	10R	-	-	+	-	+	-	-	+
-	MX 30	0R	-	-	-	-	5R	-	-	+	-	+	-	-	+
-	MX 31	0R	+	+	-	-	5R	-	-	+	-	+	-	-	+
-	MX 58	0R	+	-	-	-	0R	-	-	+	+	+	-	-	+
-	MX 72	0R	+	+	+*	+	5MS	-	-	+	-	+	-	-	+
-	MX 107	0R	-	-	+	+	10S	-	-	+	-	+	-	-	+
-	Dakold 97	0R	-	-	-	-	10MS	-	-	+	-	+	-	-	+
-	MX 101 Caniero/Zilo	0R	-	-	+	-	0R	-	-	+	+	+	-	-	+
3879	Ardi 1/Topo 1419// Erizo	40S	+	+	+*	+	70S	-	-	+	-	-	-	-	+
-	Passi 4/NIMIR	0R	-	-	+*	-	15MR	-	-	+	-	+	-	-	+
737	Caborca 79	0R	+	-	+*	+	0R	-	-	+	-	+	-	-	+
1704	Tiga	0R	-	-	+*	-	5MR	-	-	+	+	+	-	-	+
3723	WANAD	0R	-	-	+	-	15MR	-	-	+	+	+	-	-	+
3877	Pollmer 2.1.1	0R	-	-	+	-	10MR	-	-	+	+	+	-	-	+
3878	Fahad 8-2*2//PTP	10R	-	-	+	-	10MR	-	-	+	-	+	-	-	+
3878	Fahad 8-2*2// PTP U 3878	0R	-	-	+	+	70MS	-	-	+	+	+	-	-	+
827	Coorong	0R	-	-	+	-	5MR	-	-	+	+	+	-	-	+
-	Rubyk	0R	-	-	+	-	0R	-	-	+	+	+	-	-	+
3928	Ruslo	0R	-	-	+	-	10MS	-	-	+	-	+	-	-	+

3887	Uliana	0R	-	-	+*	-	5R	-	-	+	-	+	-	-	+
-	Inessa	0R	-	-	+*	-	10MR	-	-	+	-	+	-	-	+
-	Polissia	0R	-	-	-	-	50S	-	-	+	-	+	-	-	+
3889	Lotos	5MR	-	-	-	-	10S	-	-	+	-	+	-	-	+
567	Nemyga 2	20R	-	-	+	-	10R	-	-	+	-	+	-	-	+
3644	Ukro	0R	-	-	+	-	5R	-	-	+	-	+	-	-	+
-	No. 7 (Rovnia x Lotos)	0R	+	-	+*	-	15MR	-	-	+	-	+	-	-	+
-	No. 11 (Hrebeshok x T722)	10R	-	-	+	-	10MR	-	-	+	-	+	-	-	+
-	No. 15 (Pamiat Merezhko x Amigo)	0R	+	-	+*	-	70S	-	-	+	-	+	-	-	+
-	No. 20 (Prado x Mateika)	0R	+	+	+*	+	0R	-	-	+	-	+	-	-	+
3645	Dagvo	20MR	-	-	+*	-	10MR	-	-	+	+	+	-	-	+
3677	Zolotoy hrebeshok	0R	+	+	-	-	0R	-	-	+	-	+	-	-	+
-	Haikar	10MR	-	-	+	-	10MR	-	-	+	+	+	-	-	+
-	Saur	0R	-	-	+	-	10MR	-	-	+	+	+	-	-	+
3606	Prag 499	0R	-	-	+	-	5MS	-	-	+	-	+	-	-	+
3608	Prag 501	0R	-	-	+*	-	10MR	-	-	+	-	+	-	-	+
3827	Prag 503	0R	-	-	+*	+	5MR	-	-	+	-	+	-	-	+
-	L 5635	0R	-	-	+	-	0R	-	-	+	-	+	-	-	+
-	L2118	0R	-	-	+	-	5MS	-	-	+	-	-	-	-	+
-	L2226	0R	-	-	+*	-	10R	-	-	+	-	+	-	-	+
3898	Mykola	0R	-	-	+	-	10S	-	-	+	-	+	-	-	+
3892	Korovai kharkivskyi	0R	-	-	+	+	5MR	-	-	+	-	+	-	-	+
3873	Solovei kharkivskyi	30MR	+	-	+	-	0R	-	-	+	-	+	-	-	+
3891	Lehin kharkivskyi	30S	-	-	+	-	10MS	-	-	+	+	+	-	-	+
3922	Victoria	0R	-	-	+	-	10MR	-	-	+	-	+	-	-	+
3894	YaTKh-42	0R	-	-	+	-	30MS	-	-	+	-	+	-	-	+
-	Krupylskyi	0R	+	-	+	+	30MR	-	-	+	-	+	-	-	+
-	Muiz	0R	-	-	-	-	0R	-	-	+	-	+	-	-	+
3725	Mieszko	5MS	+	-	+	-	20MR	-	-	+	+	+	-	-	+
-	Duplet	0R	-	-	+*	+	10S	-	-	+	-	+	-	-	+
-	L-105/08	20MS	-	-	+*	-	10MR	-	-	+	-	+	-	-	+
-	AC Certa	0R	-	-	+*	+	5MR	-	-	+	+	+	-	-	+
3529	Papion	0R	-	-	+*	-	5MS	-	-	+	-	+	-	-	+

3531	Peura 5-1	40MS	-	-	+*	+	5R	-	-	+	-	+	-	-	+
3631	Primevara 5	0R	-	-	+*	+	60MS	-	-	+	-	+	-	-	+
-	ES 1008	0R	-	-	+	+	40MS	-	-	+	-	+	-	-	+
8750	Addax	0R	+	+	-	+	50MS	-	-	+	-	-	-	-	+
1538	Anteater	5R	-	-	-	-	0R	-	-	+	-	+	-	-	+
95843	Bacum	0R	+	+	-	-	20MS	-	-	+	-	-	-	-	+
10974	Lobo	10MR	+	-	-	+	40MS	-	-	+	-	-	-	-	+
1966	Badger	0R	-	-	-	-	60MS	-	-	+	-	-	-	-	+
160622	Bronco 90	0R	-	-	-	-	100S	-	-	+	-	-	-	-	+
4928	Bruin 46	0R	-	-	-	-	10MR	-	-	+	-	-	-	-	+
3101	Bura	0R	+	+	-	-	30MS	-	-	+	-	-	-	-	+
96102	Caborca 79	0R	-	-	-	-	10R	-	-	+	-	-	-	-	+
176515	Cheetah	0R	+	+	-	-	60 MS	-	-	+	-	-	-	-	+
96016	Currency	0R	+	+	-	-	60 MR	-	-	+	-	-	-	-	+
398542	Ningadhu	0R	-	-	-	-	30 MR	-	-	+	-	-	-	-	+
117536	Esel	0R	+	+	+	-	70MR	-	-	+	-	-	-	-	+
101744	Fawn	5R	-	-	-	+	20MS	-	-	+	-	-	-	-	+
95821	Gazelle	30S	+	+	-	-	10MR	-	-	+	-	-	-	-	+
401798	Mexitol_1	0R	-	-	-	-	20MS	-	-	+	-	-	-	-	+
649	Tarasca 87_1/YOGUI_1	0R	+	+	-	-	0R	-	-	+	-	-	-	-	+
9893	Siskiyou	0R	-	-	-	-	40S	-	-	+	-	-	-	-	+
101235	Terrier	0R	-	-	-	-	10R	-	-	+	-		-	-	+
405555	Toort	0R	-	-	-	-	0R	-	-	+	-	-	-	-	+
2740	IA-T	0R	+	+	-	-	70MS	-	-	+	-	-	-	-	+
117425	Yoco	0R	+	+	-	-	100S	-	-	+	-	-	-	-	+
5033	Camel	0R	+	+	-	-	40S	-	-	+	-	-	-	-	+
7483	Lince	0R	+	+	-	-	30S	-	-	+	-	-	-	-	+
96145	Towan	0R	+	+	-	-	20S	-	-	+	-	-	-	-	+
1963	Triticale 1	0R	-	-	+	-	10S	-	-	+	-	-	-	-	+
405902	Triticale 2	0R	-	-	-	-	5R	-	-	+	-	+	-	-	+
407007	Vaca	0R	+	+	-	-	100S	-	-	+	-	+	-	-	+
407110	Whale	0R	+	-	-	-	20S	-	-	+	-	+	-	-	+
407202	Wombat	0R	-	-	-	-	20MR	-	-	+	-	+	-	-	+
5240534	Zebra 357	0R	-	-	-	-	0R	-	-	+	-	+	-	-	+
Susceptible standard	Saratovskaya 29	60S					70S								
	Morocco	*50S*					*70S*								
Control with gene Lr9	*Transfer/6*TC (RL6010)*	*20MS*					*40S*	-	+						
	Phyton Lr9	*10 MR*					*10MS*	+	+						

Control with gene Lr28	*CS2D-2M*	*30S*					*5R*			+	+				
Control with gene Lr35	*RL5711*	*10MS*					*40MS*					-	+	-	-
Control with gene 39	*RL5711 Kerber*	*10 MR*					*10MR*					+	+	+	-
Control with gene Sr2	*Pavon 76*	*10MR*	+	+			*0R*								
Control with gene Sr22	*Mq*6//Stewart*3/RL 5244*	*20MS*			+	+	*40MS*								
	Total:		28	19	20	17		0	0	86	14	59	0	0	86

*- Presence of an amplification fragment indicates the absence of a gene.