ПРИЛОЖЕНИЕ
к статье С.Э. Смоленской, Н.П. Гончарова
«Аллельное разнообразие генов *Vrn* и контроль типа и скорости развития у пшениц»

Allelic variation in VRN loci of cultivated wheat species and relationship with heading date

Locus/ gene	Allele	Mutation	Accession	Heading date	References
		Diploid wheat (2*n* = 2*x* = 14)			
VRN-A1	*Vrn-A^{m}1*	3-bp del. in the promoter region	*T. monococcum* ssp. *aegilopoides* G2528		Yan et al., 2003
	Vrn-1f	1-bp del. in a CArG-box motif in the promoter region + 502-bp ins. in the intron 1	*T. monococcum* PI 503874		Dubcovsky et al., 2006
	Vrn-1f	1-bp del. in a CArG-box motif in the promoter region	*T. monococcum* TRI 28871		Shcherban et al., 2015b
	Vrn-1g like	34-bp del. in a CArG-box motif in the promoter region	*T. monococcum* K-18105		Golovnina et al., 2010
	Vrn-1g like	34-bp del. in a CArG-box motif in the promoter region	*T. boeoticum* K-40117 (w)		Golovnina et al., 2010
	Vrn-1h	9-bp del. in the promoter region + 493 bp ins. in intron 1	*T. monococcum* PI 306540 (w)	+	Dubcovsky et al., 2006
	Vrn-1h like	20 bp or 34 bp del. in the promoter region	*T. boeoticum* IG 116198, PI 427328		Golovnina et al., 2010
	Vrn-A1ins	0.5 kb ins. in intron 1	*T. monococcum* KM 586653		Shcherban et al., 2015b
	Vrn-A1^u		*T. boeoticum* TRI 17174, *T. urartu* TRI 17118		Shcherban et al., 2015b
WAP1	*mvp-1* mutant	19 kb del., includes promoter and coding region	*T. monococcum* KU-104-2	+	Shitsukawa et al., 2007
VRN-D	*Vrn-D^{t}1*	5437 del. in intron 1	*Ae. taucshii* Coss. KU-20-6		Takumi et al., 2011
	New allele	3273 bp del. in the intron 1	*Ae. taucshii* K-992	+	Chepurnov et al., 2023
		Tetraploid wheat (2*n* = 4*x* = 28)			
VRN-1 VRN-A1		7222-bp del. in intron 1	*T. durum* cv. Langdon		Fu et al., 2005
VRN-A1	*Vrn-A1b*	20-bp del. + 1-bp del. in the promoter region (other than 2*n* = 42)	*T. durum* US:ST 36		Yan et al., 2004a
	Vrn-A1b like	20-bp del. in the promoter region	*T. turanicum*		Golovnina et al., 2010
	Vrn-A1b	19-bp del. in the promoter region	*T. aethiopicum* IG 46273, IG 46306, IG 115810		Shcherban et al., 2015b
	Vrn-A1b.1 - Vrn-A1b.5	20-bp del. + 1-bp del. in the promoter region + polymorphism of the A-tract within the VRN-box in the promoter region	*T. turgidum* PI 264954, PI 223173 (w), *T. spelta* PI 348700, *T. macha* PI 428178 (i)		Muterko et al., 2016
	Vrn-A1d	32-bp del. in the promoter region	*T. dicoccoides* FA 15, Tabigha 15, Amrim 34, Iraq 8736		Yan et al., 2004b
	Vrn-A1e	54-bp del. in the promoter region	*T. dicoccum* ST 27 (=Vernal)		Yan et al., 2004b
	Vrn-A1e like	54-bp del. in the promoter region	*T. durum* (spring line of cv. Kristall (*Vrn-D4*), Odessa)		Golovnina et al., 2010
	Vrn-A1f	50-bp del. in the promoter region	*T. turanicum* K-15993		Golovnina et al., 2010
	Vrn-A1f like	short deletions in promoter region + MITE element ins. in the intron 1+ wide deletion in the intron 1	Line 8.1 (*T. militinae* 2*n* = 28) × cv. Tähti (2*n* = 42)	+	Ivaničová et al., 2016
	VRN-A1f-del	50-bp del. in the promoter region + 2.7- kb deletion in a central part of intron 1,	*T. araraticum* PI 427403 (w)		Shcherban et al., 2016
	Vrn-A1f-ins	50-bp del. in the promoter region + 0.4 kb ins. of MITE element in the intron 1	*T. timopheevii*		Shcherban et al., 2016
	Vrn-A1f-del/ins	50-bp del. in the promoter region + 0.4 kb ins. of a MITE element + 2.7-kb del. in the intron 1	*T. timopheevii* K-29551, K-29558, PI 119442		Shcherban et al., 2016

Продолжение приложения

Locus/ gene	Allele	Mutation	Accession	Heading date	References
	Vrn-1g	34-bp del. in a CArG-box motif in the promoter region	*T. dicoccum* PI 326317		Dubcovsky et al., 2006
	Vrn-A1g	34-bp del. in a CArG-box in the promoter region	Tetraploid line from PI 428276		Golovnina et al., 2010
	Vrn-A1i	Mutation of A to C (A3 instead of A5) within the VRN box	*T. turgidum* *T. durum*	+	Muterko et al., 2016
	Vrn-A1k	42-bp ins. in the promoter region	*T. dicoccum*		Muterko, Salina, 2017
VRN-B1	*Vrn-B1a*	127-bp ins. in the promoter region	*T. turanicum* Jakubz. K-11597		Golovnina et al., 2010
	Vrn-B1c	5463-bp ins. of the retrotransposon. _VRN element within the 5′UTR of *Vrn-B1* in a position near the CArG-box and VRN-box regulatory sites of VRN-A1 in di- and hexaploid wheat	*T. turgidum* subsp. *carthlicum,* PI 94749 *T. turgidum* subsp. *dicoccum*		Chu et al., 2011
	Vrn-B1s	2, 3 and 7 bp short deletions in the promoter region	*T. dicoccum* UA 0300212, *T. dicoccoides* PI 256029, *T. turgidum* PI 208912, *T. durum* PI 74830	+	Muterko et al., 2016
VRN-G1	*Vrn-G1a*	196-bp ins. in the promoter region	*T. timopheevii* K-38555		Golovnina et al., 2010
	Vrn-G1a	0.2-kb ins. MITE transposable elements in the promoter	*T. araraticum,* PI 654340 (w), *T. timopheevii* PI 119442		Shcherban et al., 2016
VRN-3	*Vrn-A3*	1(C) SNP +7 and 25 bp indel in the promoter region	*T. dicoccum* (TN 26)	+	Nishimura et al., 2018
VRN-A3 chr 7AS**	*Vrn-A3a-h1*	7-bp ins. in the promoter region of VRN-A3 locus	*T. dicoccum* (TN 26)	+	Nishimura et al., 2021
	Vrn-A3	1(T) SNP + 7 and 25 bp indel in the promoter region	*T. dicoccum* (TN 28)		Nishimura et al., 2018
	Vrn-A3a-h2	7-bp ins. that included a *cis*-element GATA box sequence at the promoter region of VRN-A3 locus	*T. dicoccum* (TN 28)		Nishimura et al., 2018
			Hexaploid wheat (2*n* = 6*x* = 42)		
VRN-A1	*vrn-A1*	Native	i: Triple Dirk C		Yan et al., 2004b
	Vrn-A1a	222-bp or 131-bp insertion in the promoter region	i: Triple Dirk D	+	Yan et al., 2004b
		222-bp insertion in the promoter region	cv. Jupateko		Golovnina et al., 2010
	Vrn-A1a.1	222-bp insertion in the promoter region	*T. compactum*		Muterko et al., 2016
	Vrn-A1a.2	16 bp del. and 4 single nucleotide deletions within the MITE insertion when compared to *Vrn-A1a.1*	*T. compactum* PI 352302		Muterko et al., 2016
	Vrn-A1b	20-bp deletions in the promoter region	cv. Marquis (PI 94548), (IL 12 and IL 425), (GR 46), (IL 63 and IL 66)		Yan et al., 2004b
	Vrn-A1b like	(8 unique SNPs + 5 unique 1-bp indels + 5504-bp del.) in intron 1	IL 369 (Afghanistan)		Fu et al., 2005
	Vrn-A1b like	20-bp deletions in the promoter region	s: Saratovskaya 29/ Vietnamskaya 5R(5A)		Golovnina et al., 2010
	Vrn-A1b	20-bp deletions in the promoter region +177 bp ins. in intron 1	cv. Pyrothrix 28, Rescue, VL-30		Strejčková et al., 2021, 2023
	Vrn-A1c like *vrn-A1*	Three diagnostic SNP nucleotide polymorphisms within an 810-bp region between intron 4 and exon 8 of the *VRN-A1* gene	IL 369 (Afghanistan), IL 162 (Egypt)		Yan et al., 2004b

Окончание приложения

Locus/ gene	Allele	Mutation	Accession	Heading date	References
	Vrn-A1f-like	8-bp + 50-bp del. in the promoter region	nulli5B-tetra5D Chinese Spring		Golovnina et al., 2010
	Vrn-Ai2	1807 and 7804-bp del. in intron 1	NILs cv. Sunstate	+	Steinfort et al., 2017
VRN-B1	*VrnB1a*	6850-bp del. in intron 1	i: Triple Dirk B		Fu et al., 2005
	VrnB1b	6850-bp del. in intron 1+36-bp del. in intron 1	Alpowa	+	Santra et al., 2009
	VrnB1c	6850-bp del. in intron 1+ 0.8-kb del. and 0.4-kb duplication in intron 1	NILs Saratovskaya 29 & Diamant II	+	Shcherban et al., 2012a
	VrnB1c	800-bp del. in intron 1 + duplications/ translocatios around 450-bp	cvs Granny, Kaerntner Frueher, Linda, Paragon, Quarna, Septima, Sirael		Milec et al., 2012
	VrnB1d	(6850-bp del. +187-bp del.+ SNP (T to C), + mutation 4 bp (TTTT to ACAA)) in intron 1	cv. Hongchunmai	+	Zhang B. et al., 2018
	VrnB1f	836-bp ins. in intron 1	cvs Anza, Barta and Marquis	+	Strejčková et al., 2021
VRN-D1	*VrnD1a*	4235-bp del. in intron 1	i: Triple Dirk E		Fu et al., 2005
	Vrn-D1b	4235-bp del. in the intron 1+SNP in the CArG-box at the promoter region	*T. aestivum*	+	Zhang J. et al., 2012
	VrnD1c	174-bp insertion in 5′-UTR	cv. Yunong 876	+	Zhang X. et al., 2015
	Vrn-D1s	844-bp ins. in intron 1	*T. spelta* L., *T. compactum* Host		Muterko et al., 2015
	Vrn-D1x	163-bp ins. in intron 1	Mex. 3, Mex. 17	(w)	Makhoul et al., 2022
VRND1	*vrn-D1r*	17-bp del. in intron 1	cv. Robigus	(w)	Makhoul et al., 2022
VRN-2*					Kippes et al., 2016
VRN-3 VRN-B3 *TaFT* chr 7BS		5,295-bp (retrotransposon) ins. in the promoter region +6SNP+3SNP in intron 1	CS/Hope 7B		Yan et al., 2006
VRN-B3	*Vrn-B3a*	5300-bp ins. in the promoter region	cv. Hemai 26	*Vrn-A1*-null allele	Chen F. et al., 2013
	Vrn-B3b	5′ UTR 890-bp ins. in the promoter region	cv. Chadianhong	+	Chen F. et al., 2013
	Vrn-B3c	(5300-bp ins. + 20-bp del. +4-bp del.) in the promoter region	cv. Ji		Chen F. et al., 2013
	Vrn-B3d	1617 bp ins. (retrotransposon) in the promoter region	line Velut	+	Berezhnaya et al., 2021
	Vrn-B3e	160 bp ins. in the promoter region	Altaiskaya, Mana2, Mariya, Obskaya 14, Omskaya 23, Novosibirskaya 29, 67, 89	+	Berezhnaya et al., 2021
VRN-A3		SNP (T–G) within the third exon	RIL Yi5029 × Nongda4332	+	Chen Z. et al., 2020
VRN-D4		3SNP in RIP-3 region of the intron 1	*T. sphaerococcum*		Kippes et al., 2015
VRN-D4			i: Triple Dirk F		Kippes et al., 2015

Note. Bp – base pairs; del. – deletion; ins. – insertion; indel – insertion/deletion; "+" – allele is associated with heading date; (w) – winter.

* To study the *Vrn-2* gene in hexaploid wheat, a synthetic *vrn2-null* mutant was produced by combining the non-functional *Vrn-A2* allele, which are present in most polyploid wheats, with the *Vrn-B2* deletion from tetraploid wheat and the non-functional *Vrn-D2* allele from *Ae. tauschii* (Kippes et al., 2016).

** To study the *Vrn-2* gene in tetraploid wheat, line #3089 (BC3F2 521 × Kronos) with non-functional alleles *vrn-A2* and *vrn-B2* was produced (Distelfeld et al., 2009).