

Whole genome identification of *CBF* gene families and expression analysis in *Vitis vinifera* L.

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Electronic Supplementary Material (ESM)

The authors are fully responsible for both the content and the formal aspects of the electronic supplementary material. No editorial adjustments were made.

Table S1. Primer sequences used in RT-qPCR

Gene name	Forward primer sequence	Reverse primer sequence
<i>VviCBF1</i>	AAGGTGATCAAGCGGAGCTAAT	AATTGATGACTGACGTCGAGGA
<i>VviCBF3</i>	AAGGTGATCAAGCGGAGCTAAT	AATTGATGACTGACGTCGAGGA
<i>VviCBF4</i>	ACTTCCCGGACTTTGTTCACCTC	ACATCGAACHTCCCATCATCTT
<i>VviCBF5</i>	CAAGACHATTCAAGTGGAGACG	AGGAGGAGAATGTAGGGGCTCT
<i>VviCBF6</i>	ATCATTGTCGTCATTGGTGTCC	CGGAGAAATACHCACAATCCTC
<i>VviCBF7</i>	GCTAAGGCTTTTCAGCAACHTC	ATCGATGAAACTCCCACAACHT
<i>VviCBF11</i>	ACHAAGTTCGGAAGCTGAGAGT	CCCTCTGTACACTGGGTGTCTG
<i>VviCBF12</i>	TACAGGAGACACGACACHCAGT	AACGCTAATGCAGCAACATCAT
<i>VviCBF13</i>	ACTCAGAAACGGAGTGTTGCAG	CTCTGTACACTGGGTGCTTGCT
<i>VviCBF15</i>	TACHTCCCCTAAGGACATCCAA	AAAAACGCGTCATCGTTGTCTA
<i>VviCBF16</i>	ACTAAGAAAAGCGGGACAGACG	GAACCTCCCATGCACAATCATTC
<i>VviCBF17</i>	GATTCCCTGAATTTGCCTGATT	CATATCCTGGACGTCTTGTGG
<i>VviCBF18</i>	CACHTTGAATTTTCCCAACTCC	CTCCTTTTGTAGGTTGGGTGGTG

Table S2. The cis-elements analysis result of *VviCBFs*

Type	Motif	Gene	No.	Total
Light	3-AF1 binding site	<i>VviCBF5</i>	1	18
	ACE	<i>VviCBF3</i> , <i>VviCBF6</i> , <i>VviCBF8</i>	3	
	AE-box	<i>VviCBF5</i> , <i>VviCBF7</i> , <i>VviCBF8</i> , <i>VviCBF11</i> , <i>VviCBF13</i> , <i>VviCBF17</i>	6	
	AT1-motif	<i>VviCBF6</i> , <i>VviCBF8</i>	2	
	ATCT-motif	<i>VviCBF17</i>	1	
	Box 4	<i>VviCBF1</i> , <i>VviCBF2</i> , <i>VviCBF3</i> , <i>VviCBF4</i> , <i>VviCBF5</i> , <i>VviCBF6</i> , <i>VviCBF7</i> , <i>VviCBF8</i> , <i>VviCBF9</i> , <i>VviCBF10</i> , <i>VviCBF11</i> , <i>VviCBF12</i> , <i>VviCBF13</i> , <i>VviCBF14</i> , <i>VviCBF15</i> , <i>VviCBF16</i> , <i>VviCBF17</i> , <i>VviCBF18</i>	18	
	Box II	<i>VviCBF1</i> , <i>VviCBF3</i> , <i>VviCBF9</i>	3	
	chs-CMA1a	<i>VviCBF7</i> , <i>VviCBF8</i> , <i>VviCBF9</i> , <i>VviCBF16</i>	4	
	chs-CMA2a	<i>VviCBF6</i> , <i>VviCBF8</i>	2	
	G-box	<i>VviCBF1</i> , <i>VviCBF2</i> , <i>VviCBF3</i> , <i>VviCBF4</i> , <i>VviCBF5</i> , <i>VviCBF6</i> , <i>VviCBF7</i> , <i>VviCBF8</i> , <i>VviCBF9</i> , <i>VviCBF10</i> , <i>VviCBF11</i> , <i>VviCBF12</i> , <i>VviCBF13</i> , <i>VviCBF15</i> , <i>VviCBF16</i> , <i>VviCBF17</i> , <i>VviCBF18</i>	17	
	GA-motif	<i>VviCBF7</i> , <i>VviCBF8</i>	2	
	Gap-box	<i>VviCBF1</i> , <i>VviCBF3</i> , <i>VviCBF5</i> , <i>VviCBF11</i>	4	
	GATA-motif	<i>VviCBF2</i> , <i>VviCBF4</i> , <i>VviCBF5</i> , <i>VviCBF7</i> , <i>VviCBF8</i> , <i>VviCBF9</i> , <i>VviCBF12</i> , <i>VviCBF13</i> , <i>VviCBF14</i> , <i>VviCBF16</i> , <i>VviCBF17</i>	11	
	GT1-motif	<i>VviCBF1</i> , <i>VviCBF2</i> , <i>VviCBF3</i> , <i>VviCBF4</i> , <i>VviCBF7</i> , <i>VviCBF8</i> , <i>VviCBF9</i> , <i>VviCBF10</i> , <i>VviCBF15</i>	9	
	I-box	<i>VviCBF2</i> , <i>VviCBF5</i> , <i>VviCBF6</i> , <i>VviCBF7</i> , <i>VviCBF9</i> , <i>VviCBF11</i> , <i>VviCBF12</i> , <i>VviCBF13</i> , <i>VviCBF16</i> , <i>VviCBF17</i>	10	
	LAMP-element	<i>VviCBF2</i> , <i>VviCBF5</i> , <i>VviCBF14</i> , <i>VviCBF15</i> , <i>VviCBF17</i>	5	
	MRE	<i>VviCBF9</i> , <i>VviCBF10</i> , <i>VviCBF15</i> , <i>VviCBF18</i>	4	
	Sp1	<i>VviCBF10</i> , <i>VviCBF12</i> , <i>VviCBF13</i> , <i>VviCBF14</i> , <i>VviCBF16</i>	5	
	TCCC-motif	<i>VviCBF4</i> , <i>VviCBF5</i> , <i>VviCBF6</i> , <i>VviCBF7</i> , <i>VviCBF10</i> , <i>VviCBF14</i>	6	
	TCT-motif	<i>VviCBF1</i> , <i>VviCBF2</i> , <i>VviCBF3</i> , <i>VviCBF8</i> , <i>VviCBF11</i> , <i>VviCBF13</i> , <i>VviCBF14</i> , <i>VviCBF15</i> , <i>VviCBF17</i> , <i>VviCBF18</i>	10	
Absciscic acid	ABRE	<i>VviCBF1</i> , <i>VviCBF2</i> , <i>VviCBF3</i> , <i>VviCBF4</i> , <i>VviCBF5</i> , <i>VviCBF6</i> , <i>VviCBF7</i> , <i>VviCBF8</i> , <i>VviCBF9</i> , <i>VviCBF10</i> , <i>VviCBF11</i> , <i>VviCBF12</i> , <i>VviCBF13</i> , <i>VviCBF15</i> , <i>VviCBF16</i> , <i>VviCBF17</i>	17	17
MeJA	CGTCA-motif	<i>VviCBF1</i> , <i>VviCBF3</i> , <i>VviCBF4</i> , <i>VviCBF5</i> , <i>VviCBF6</i> , <i>VviCBF7</i> , <i>VviCBF8</i> , <i>VviCBF9</i> , <i>VviCBF10</i> , <i>VviCBF12</i> , <i>VviCBF13</i> , <i>VviCBF14</i> , <i>VviCBF16</i> , <i>VviCBF17</i> , <i>VviCBF18</i>	15	15
	TGACG-motif	<i>VviCBF1</i> , <i>VviCBF3</i> , <i>VviCBF4</i> , <i>VviCBF5</i> , <i>VviCBF6</i> , <i>VviCBF7</i> , <i>VviCBF8</i> , <i>VviCBF9</i> , <i>VviCBF10</i> , <i>VviCBF12</i> , <i>VviCBF13</i> , <i>VviCBF14</i> , <i>VviCBF16</i> , <i>VviCBF17</i> , <i>VviCBF18</i>	15	
Anaerobic induction	ARE	<i>VviCBF1</i> , <i>VviCBF2</i> , <i>VviCBF3</i> , <i>VviCBF4</i> , <i>VviCBF5</i> , <i>VviCBF6</i> , <i>VviCBF7</i> , <i>VviCBF8</i> , <i>VviCBF9</i> , <i>VviCBF10</i> , <i>VviCBF11</i> , <i>VviCBF12</i> , <i>VviCBF13</i> , <i>VviCBF14</i> , <i>VviCBF15</i> , <i>VviCBF16</i> , <i>VviCBF17</i> , <i>VviCBF18</i>	18	18
MYB binding site involved in drought-inducibility	MBS	<i>VviCBF2</i> , <i>VviCBF7</i> , <i>VviCBF9</i> , <i>VviCBF10</i> , <i>VviCBF11</i> , <i>VviCBF12</i> , <i>VviCBF14</i> , <i>VviCBF18</i>	8	8

<https://doi.org/10.17221/82/2022-CJGPB>

Table S2 to be continued

Type	Motif	Gene	No.	Total
Zein metabolism	O2-site	<i>VviCBF3</i> , <i>VviCBF12</i> , <i>VviCBF13</i> , <i>VviCBF14</i> , <i>VviCBF15</i> , <i>VviCBF16</i> , <i>VviCBF17</i>	7	7
Gibberellin	P-box	<i>VviCBF4</i> , <i>VviCBF5</i> , <i>VviCBF7</i> , <i>VviCBF11</i> , <i>VviCBF13</i> , <i>VviCBF14</i> , <i>VviCBF17</i>	7	7
	TATC-box	<i>VviCBF14</i>	1	
Salicylic acid	TCA-element	<i>VviCBF4</i> , <i>VviCBF5</i> , <i>VviCBF8</i> , <i>VviCBF9</i> , <i>VviCBF11</i> , <i>VviCBF12</i> , <i>VviCBF18</i>	7	7
Auxin	AuxRR-core	<i>VviCBF2</i> , <i>VviCBF13</i> , <i>VviCBF18</i>	3	6
	TGA-box	<i>VviCBF18</i>	1	
	TGA-element	<i>VviCBF6</i> , <i>VviCBF8</i> , <i>VviCBF10</i>	3	
Binding site of ATBP-1	AT-rich element	<i>VviCBF5</i> , <i>VviCBF6</i> , <i>VviCBF9</i> , <i>VviCBF12</i> , <i>VviCBF13</i> , <i>VviCBF14</i>	6	6
Meristem expression	CAT-box	<i>VviCBF2</i> , <i>VviCBF7</i> , <i>VviCBF10</i> , <i>VviCBF12</i> , <i>VviCBF14</i> , <i>VviCBF18</i>	6	6
Endosperm expression	GCN4_motif	<i>VviCBF2</i> , <i>VviCBF4</i> , <i>VviCBF6</i> , <i>VviCBF8</i> , <i>VviCBF11</i> , <i>VviCBF17</i>	6	6
Circadian control	circadian	<i>VviCBF12</i> , <i>VviCBF13</i> , <i>VviCBF14</i> , <i>VviCBF17</i>	4	4
Anoxic specific	GC-motif	<i>VviCBF13</i> , <i>VviCBF14</i>	2	2
Defense and stress	TC-rich repeats	<i>VviCBF8</i> , <i>VviCBF13</i> , <i>VviCBF18</i>	3	3
Low-temperature	LTR	<i>VviCBF1</i> , <i>VviCBF6</i> , <i>VviCBF14</i>	3	3
Seed-specific	RY-element	<i>VviCBF1</i> , <i>VviCBF3</i> , <i>VviCBF7</i>	3	3
Cis-acting regulatory element	A-box	<i>VviCBF10</i> , <i>VviCBF12</i>	2	2
Wound	WUN-motif	<i>VviCBF5</i> , <i>VviCBF14</i>	2	2
Cell cycle regulation	MSA-like	<i>VviCBF11</i>	1	1
Differentiation of the palisade mesophyll cells	HD-Zip 1	<i>VviCBF10</i>	1	1

Table S3. The data of *VviCBFs* gene expression profile during grapevine fruit development

Gene name	Green	Veraison	Veraison/green_log ₂ FC	Mature	Mature/veraision_log ₂ FC
<i>VviCBF5</i>	42.26	28.92	-0.55	10.29	0.24
<i>VviCBF13</i>	21.13	2.34	-3.18	1.07	0.05
<i>VviCBF14</i>	8.07	1.31	-2.62	0.20	0.03
<i>VviCBF15</i>	6.94	0.57	-3.61	0.04	0.01
<i>VviCBF16</i>	7.07	0.12	-5.85	0.03	0.00
<i>VviCBF18</i>	9.47	31.27	1.72	51.92	5.48

Table S4. The data of *VviCBFs* gene expression profile under abiotic stress and biotic stress

Gene name	CK	Drought	log ₂ FC
<i>VviCBF12</i>	0.001	0.261092976	8.028419836
<i>VviCBF2</i>	0.001	0.054918499	5.779220292
<i>VviCBF11</i>	0.180594174	0.505106491	1.483836234
<i>VviCBF4</i>	2.434304514	0.001	-11.24929393
<i>VviCBF17</i>	171.5714045	0.320692882	-9.063401072
<i>VviCBF15</i>	0.37329166	0.001	-8.544159468
<i>VviCBF7</i>	21.6811326	0.089275344	-7.923962617
<i>VviCBF18</i>	89.34320275	0.38190515	-7.869999788
<i>VviCBF16</i>	14.43111623	0.062480806	-7.851554121
<i>VviCBF5</i>	350.6965942	1.519184603	-7.85078242
<i>VviCBF13</i>	106.6092055	1.638334339	-6.023958407
<i>VviCBF1</i>	3.086655417	0.227187152	-3.76409128
<i>VviCBF6</i>	6.212756909	0.727911368	-3.093398905
<i>VviCBF8</i>	0.499189555	0.073483715	-2.76409128
<i>VviCBF14</i>	2.091642022	0.589600202	-1.826827035
<i>VviCBF3</i>	3.517410797	1.114361423	-1.658296616
Waterlogging			
<i>VviCBF17</i>	152.9649538	52.19505134	-1.551216216
<i>VviCBF16</i>	12.03272439	0.082991265	-7.179788123
<i>VviCBF7</i>	21.36086316	1.126525168	-4.245018495
<i>VviCBF18</i>	85.80639415	194.5389839	1.180902223
<i>VviCBF1</i>	6.187197171	1.293280539	-2.258250751
<i>VviCBF3</i>	8.145466607	0.269121962	-4.919665312
<i>VviCBF13</i>	110.1702234	31.84047141	-1.790800747
Copper stress			
<i>VviCBF17</i>	152.9649538	56.90152573	-1.426661909
<i>VviCBF4</i>	2.421436062	7.848300604	1.696517391
<i>VviCBF14</i>	2.217412625	9.484600872	2.096709806
Salt stress			
<i>VviCBF17</i>	152.9649538	27.07673913	-2.498075241
<i>VviCBF7</i>	21.36086316	5.270980522	-2.01882668
<i>VviCBF5</i>	354.6287566	133.2618161	-1.412046069
<i>VviCBF18</i>	85.80639415	20.8758376	-2.039251075
<i>VviCBF1</i>	6.187197171	20.55199713	1.731920679
<i>VviCBF3</i>	8.145466607	23.74979674	1.543845916
<i>VviCBF14</i>	2.217412625	10.45607542	2.23739229
<i>VviCBF13</i>	110.1702234	53.21563639	-1.049812227

	S0h	S24h	S24h/ S0h_log ₂ FC	S72h	S72h/ S24h_log ₂ FC	R0h	R24h	R24h/R0h_ log ₂ FC	R72h	R72h/ R24h_log ₂ FC
<i>VviCBF17</i>	189.03	487.55	1.37	330.88	-0.56	1173.53	711.62	-0.72	140.23	-2.34
<i>VviCBF5</i>	834.15	798.31	-0.06	814.91	0.03	800.11	240.40	-1.73	221.52	-0.12
<i>VviCBF18</i>	424.33	270.51	-0.65	302.88	0.16	303.50	620.89	1.03	61.91	-3.33
<i>VviCBF13</i>	88.79	90.92	0.03	128.11	0.49	99.16	24.08	-2.04	48.47	1.01
<i>VviCBF7</i>	95.41	89.54	-0.09	229.81	1.36	117.77	15.31	-2.94	5.66	-1.44
<i>VviCBF4</i>	258.30	165.43	-0.64	108.21	-0.61	90.16	29.21	-1.63	1.99	-3.88

CK – control group; FC – fold change, which represents the ratio of expression quantity between two samples (groups); log₂FC is obtained after logarithm base 2 is taken



Figure S1. MEME-identified sequence motifs present in the protein sequence of *VviCBF* genes