



Fig. S1. Sequencing results of the cloned *TaEXPA2* gene.

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      10      20      30      40      50      60      70      80
TaEXPB1 1  ATGGTCCTCTTTTCGTCCAAGGCGGTTCGACTCGTTGCACCTGTTCTCCCTCCTCGTCACCTACGCCGCCGGCGCGGGAA 80
      M A P L S S K A V A L V A L F S L L V T Y A A G A G N
                                     Signal peptide ←
      90      100     110     120     130     140     150     160
TaEXPB1 81  CTTCAACGACTCCGCTTACCGCGGACCCCAACTGGGAGGACGCCAGGGCCACTGGTACGGCGCCCCACCGGGCGCG 160
      F N D S A F T A D P N W E D A R A T W Y G A P T G A

      170     180     190     200     210     220     230     240
TaEXPB1 161  GCCCTGACGACGATGGTGGTGCCTGCGGGTCAAGAACAACCAACAGTACCCCTTCTCCTCCATGACATCGTGGCGAAC 240
      G P D D D G G A C G F K N T N Q Y P F S S M T S C G N

      250     260     270     280     290     300     310     320
TaEXPB1 241  GAGCCATCTTCAAGGACGGCAAGGGTGGCGCTCCGCTACCCAGATACGATGCACCAACGACAGTCCCTGCTCCGCGAA 320
      E P I F K D G K G C G S C Y Q I R C T N D Q S C S G N

      330     340     350     360     370     380     390     400
TaEXPB1 321  CCGCGAGACGGTGGTCAACCCGACATGAACCTACTACCCGGTGGCAAGTACCCTTCGACCTGAGCGGCACCCGCTTCG 400
      P E T V V I T D M N Y Y P V A K Y E F D L S G T A F

      410     420     430     440     450     460     470     480
TaEXPB1 401  GCGCCATGGCCAGCCCGCTCAGCGAGAACTCCGCCACTCGGGCATCATCGACATCCAGTTCAGAGGGTGGCGTGC 480
      G A M A K P G L S E K L R H S G I I D I Q F K R V P C
                                     β-Insertion
      490     500     510     520     530     540     550     560
TaEXPB1 481  GAGTTCGCCGGTCTCAAGGTGACCTTCCACGTGGAGCAGGGTCCGAACCTGGTACTTTCGCGGTGCTGGTGGAGTACGA 560
      E F P G L K V T F H V E Q G S N L V Y F A V L V E Y E

      570     580     590     600     610     620     630     640
TaEXPB1 561  GGACGGCAGCGCGCGTGGTGCAGGTGGACCTCATGGAGGCCAACTCCGGGACGTGGACGCCGATGCGCGAGTATGGG 640
      D G D G D V V Q V D L M E A N S G T W T P M R E S W

      650     660     670     680     690     700     710     720
TaEXPB1 641  GTCCTACTGGCGGTTCGACTCCGGCCACCGCTCCAGGGCCCTTCTCCATGGGCATCACCAACGAGTCCGGCAAGACG 720
      G S I W R L D S G H R L Q A P F S M R I T N E S G K T

      730     740     750     760     770     780     790
TaEXPB1 721  CTGGTGGCCGACAAGGTGATCCCGGCCAAGTGGCGCCAGCACCTTCTACCGCTCCATCGTCCAGTACAGCTGA 795
      L V A D K V I P A N W A P S T F Y R S I V Q Y S *

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Fig. S2. Sequencing results of the cloned *TaEXPB1* gene.

Table S1. Characteristics of genes encoding expansin proteins in different plant species.

Gene name	Protein name	Uniprot ID	Signal peptide	Expansin-like EG45	Expansin-like CBD
AAS48871	TaEXPA2	Q6QFB1	1–29	51–163	173–254
AT1G69530.1	AtEXPA1	Q9C554	1–21	45–157	167–246
NC_029261	OsEXPA17	Q4PR49	1–21	71–185	195–279
AAK56119	ZmEXPA1	Q94KT7	1–25	49–161	171–250
AAT99292	TaEXPB1	Q6QFA3	1–24	59–165	178–259
AT1G65680.1	AtEXPB2	Q9SHY6	1–29	65–173	186–269
AF332174	ZmEXPB1	P58738	1–24	63–169	183–264
NC_029265	OsEXPB4	Q94LR4	1–24	75–181	194–281

Table S2. Primers used for cloning and transgenic vector construction of expansins in wheat

Primer name	Sequence (5' to 3')*	Annotation
CE-TaEXPA2-F	ggatcttcagagatATGGAGACGAGACGTCC AGCGGTTTCC	Cloning vector constructions for sequencing
CE-TaEXPA2-R	ctgccgttcagcatCTATCAGAATTGCCCTTTGCC CTCGAAGC	
CE-TaEXPB1-F	ggatcttcagagatATGGCTCCTCTTTTCGTC	
CE-TaEXPB1-R	ctgccgttcagcatTCAGCTGTACTGGACGAT	
1302-TaEXPA2-F	gagagaacacgggggactcttgaccatggtgATGGAGACGA GACGTCCAGC	Transgenic vector constructions: 35S::TaEXPA2::GFP and 35S::TaEXPB1::GFP
1302-TaEXPA2-R	ttctctttactagtcatgactctaccatggaGAATTGCCCTTTG CCCTCGAAGC	
1302-TaEXPB1-F	gagagaacacgggggactcttgaccatggtgATGGCTCCTC TTTTTCGTC	
1302-TaEXPB1-R	ttctctttactagtcatgactctaccatggaGCTGTACTGGACG AT	

*Lowercases represent homologous arms used for homologous recombination of vector construction.

Table S3. Primers used for qRT-PCR of expansin genes in wheat and transgenic Arabidopsis plants

Primers	Sequences (5' to 3')	Annotation
qTaEXPA2-F	AGCAAGCGGTGGCTGGATG	Real-time RT-PCR for TaEXPA2
qTaEXPA2-R	GCCGTGGCACTGGATCTCGTA	
qTaEXPB1-F	TCTCCCTCCTCGTCACCTAC	Real-time RT-PCR for TaEXPB1
qTaEXPB1-R	CCTTGAAGATGGGCTCGT	
qADP-F	GCTCTCCAACAACATTGCCAAC	Real-time RT-PCR for ADP
qADP-R	GCTTCTGCCTGTCACATACGC	
T-TaEXPA2-F	CATGTCCAAAATCTCGTCTG	PCR confirmation of the transgenic plants
T-TaEXPA2-R	AATGGTTGTCTGGTAAAAGG	
T-TaEXPB1-F	GCGTCCACGTCCCGGAGTTG	
T-TaEXPB1-R	AATGGTTGTCTGGTAAAAGG	