

The NAC-type transcription factor *OsNAC2* regulates ABA-dependent genes and abiotic stress tolerance in rice

Jiabin Shen^{#1}, Bo Lv^{#1}, Liqiong Luo^{#1}, Jianmei He², Chanjuan Mao¹, Dandan Xi¹, and Feng Ming^{1,*}

1 State Key Laboratory of Genetic Engineering, Institute of Genetics, Institute of Plant Biology, School of Life Science, Fudan University, Shanghai 200433, China

2 Rice Research Institute, Sichuan Agricultural University, Sichuan 611130, China

[#]These authors contributed equally to this work.

* Corresponding authors: F Ming, Tel: 86-21-51630555; Email: fming@fudan.edu.cn

Supplemental data

Table S1: Primers used for realtime-PCR.

| Gene names | Primer |
|-----------------|--|
| <i>OsNAC2</i> | F: gagaagtctggctgggtcat R: aacaccactcgtgtttgga |
| <i>OsACTIN</i> | F: ctgcgataatggaactgt R: acaatcctggggaagaca |
| <i>OsLEA3</i> | F: ggcgcagtacaccaagga R: acctgctcactgcctgt |
| <i>OsRAB21</i> | F: gagggaggagcacaagacc R: attccatcatcctcagacgag |
| <i>OsRAB16C</i> | F: cagttccagccggtgaag R: catcccgtcgtcctcaga |
| <i>OsRAB16D</i> | F: cgtctctccctgctttctga R: ttctcaacgggacgacaa |
| <i>OsSAPK1</i> | F: gccacagcgtatgatgcgta R: taatctctggccgctcgtg |
| <i>OsSAPK10</i> | F: tcttgacgtggaagcagtg R: tccactcccagtttcttg |
| <i>OsZIP46</i> | F: atcaagaacaggagtccegc R: gagccatcaccattaccaa |
| <i>OsZIP72</i> | F: aatgaggtagaagaaatgat R: gcacagtcgctgatgaagg |
| <i>OsASR5</i> | F: aagcaagcaaagccacatct R: cgtccttctgtgtggaac |
| <i>OsDEG10</i> | F: agcggatcgacaagtattg R: aacacaaccagcacctcatg |
| <i>OsSAP1</i> | F: acctgaggtccccttccat R: tgccttaggtggtcagaacc |
| <i>OsHKT1;5</i> | F: acctgaggtccccttccat R: tgccttaggtggtcagaacc |

Table S2: Primers used for yeast one-hybrid and ChIP-qPCR.

| Gene names | Primer |
|------------------------------------|--|
| <i>OsNAC2</i> pro-F | 5'- cggaattcgtaccctgattctaatacaggt -3' |
| <i>OsNAC2</i> pro-R | 5'- cgggatccaagtgggaggggtggtggtgcc -3' |
| <i>OsNAC2</i> -F- <i>EcoR</i> I | 5'- cagaattcatggagcagcatcagggc -3' |
| <i>OsNAC2</i> -R- <i>Xho</i> I | 5'- aaactcagtttagtagcccatagcgcg -3' |
| <i>OsLEA3</i> -F- <i>EcoR</i> I | 5'- ggaattcctcatcctttgttgatctgtgg -3' |
| <i>OsLEA3</i> -R- <i>Sma</i> I | 5'- tccccgggtgatcctaagctcaaaaatta -3' |
| <i>OsSAPK1</i> -F- <i>EcoR</i> I | 5'- ggaattcacatccgatagttaaaactttg -3' |
| <i>OsSAPK1</i> -R- <i>Mlu</i> I | 5'- cgacgcgtatcccctcaacgacctgctcc -3' |
| <i>OsABA8OX3</i> -F- <i>EcoR</i> I | 5'- ggaattctagcaaatcaacagggtatagt -3' |
| <i>OsABA8OX3</i> -R- <i>Mlu</i> I | 5'- cgacgcgtccaatgacctggagaattaa -3' |
| <i>OsRab16A</i> -F- <i>EcoR</i> I | 5'- ggaattctctcaaccttttaactaagta -3' |
| <i>OsRab16A</i> -R- <i>Mlu</i> I | 5'- cgacgcgtgtggacctggatgtgcaaaact -3' |
| <i>OsLEA3</i> pro-F1-F | 5'- atccatgaggtagcatgcaagc -3' |
| <i>OsLEA3</i> pro-F1-R | 5'- acgacgacgtatcgaacggccag -3' |
| <i>OsLEA3</i> pro-F2-F | 5'- agctgccgtatctagcttcagg -3' |
| <i>OsLEA3</i> pro-F2-R | 5'- gtggcgtggcatgctagaaaag -3' |
| <i>OsLEA3</i> pro-F3-F | 5'- cgttcttcttggctggtttac -3' |
| <i>OsLEA3</i> pro-F3-R | 5'- aatgcacggacctctgttcttc -3' |
| <i>OsLEA3</i> pro-F4-F | 5'- ccggagagagccgaagccgacg -3' |
| <i>OsLEA3</i> pro-F4-R | 5'- gacaagagaagatgttcattta -3' |
| <i>OsSAPK1</i> pro-F1-F | 5'- gtattaacataggctaaaaaa -3' |
| <i>OsSAPK1</i> pro-F1-R | 5'- tagtaacacactgtcaaatcat -3' |
| <i>OsSAPK1</i> pro-F2-F | 5'- cggatctaaacaccccataagg -3' |
| <i>OsSAPK1</i> pro-F2-R | 5'- gttaggtttgaggaggattgag -3' |
| <i>OsSAPK1</i> pro-F3-F | 5'- gcctaagggtctgttagatcc -3' |
| <i>OsSAPK1</i> pro-F3-R | 5'- acacgcaatctgtataattag -3' |

Figure S1: Promoter sequence of OsNAC2 (Primer regions are underlined).

gtaccctgattctaatacagggttcagggcaaatgattatacgtactactgtacaatccctgcagaaaattacgcacaaag
accaaatacaagggttgctatggactgaatatacttttggttgcgcctggacgtcggtagctacccagatattaattaa
ttatttgaattagtgattttgtaccaaatacgaaccagctcatgcttagcatgaagctaataaattctcccgtttattgca
gtactcgaatacaaatagtaggtgtactactcgccatggagctgctctaattcgttctcaaaagcttctggagacgaagg
attgggttggtcgctttctcggttgctgctcggctcgcgtgctgcatatgacgctttacttaatgctgctagtagtactataa
ttccattaattaagactcatttaattagtaatgcaccaaataccttaaatccagccagatcagatcaaagtcatcctagggt
aaaacactctgatctgatggatcactagccactaaattaatccggtgattgatcatgtgtggaagcaagtttggctcgtt
acaaggactattacataacactacgctgctctgtatagctatctcatctatctcttccatgcattttcacctactagcta
gtactccatccgttttaaatgtttgacaccgttgacttttagcacatgtttgaccgttcttattcaaaaattttgtga
aatatgtaaaactatatgtgtacatgaaagtataatcaataaatcgaatgatgaaaagaataaataactacttaa
atTTTTgaataagacgaatggTTaaacacgtactaaaaagTcaacggTgtcaaacattttgaaatggaggaggtagtaa
cctgtgatgagtttcttcatcaccacgtctcttctactaaaaagacatcatgtagctcgcctctagtatttaaggggca
ccaccaccctcccactttatttctctatacaacgatttctctgtcacccTgaatctacttctgctgcaaaaggtaattagcatatcctaa
ctatttatcacctcatccctcaagtgtgttcttactttcttagatgtacttttaaacTTTTctgtgcataaacatctcatgtgctgattcttttg
tgttctatgtgcttgcataccatgtccgttggTtcgattcttttaagcatccgtgtggttgttttTttagcttagctagctagctagcaa
agaggTgcatggatacataaccagctttaattgattggTttgctctaccttaaaagTgtgtgaatcatctccgtcctagtTtatgcatatctg
tgtgcatatgtacaaatgtttcaggacaggagttggcataacagctaacaatacttatatagcagcaataagcaaggagcagttagcc
aggtaaagctctagctagctagcttaggcagca

+ TATATTTAAC AATAAATCGA ATGATATGAA AAGAATAAAAT AACTACTTAA ATTTTTTGAAT AAGACGAAT
- ATATAAATGG TTATTTAGCT TACTATACCTT TTCTTATTTA TTGATGAATT TAAAAAACTTA TTCTGCTTA
GT1-motif G-Box **HSE**

+ GGTTAAACAC GTACTAAAAA GTCAACGGTG TCAAACATTT TGAAATGGAG GGAGTAGTAAC CTGTGATGA
- CCAATTTGTG CATGATTTTT CAGTTGCCAC AGTTTGTAAA ACTTTACCTC CCTCATCATTG GACACTACT
ABRE **G-box** **ERE**

+ GTTTCCTTCA TCACCCAGT CTCTTTCTAC TAAAAAGACC ATCATGTAGC TCGCCTCTAGT ATTTAAGGG
- CAAAGGAAGT AGTGGGTGCA GAGAAAGATG ATTTTTCTGG TAGTACATCG AGCGGAGATCA TAAATTCCC

+ GCACCACCAC CCCTCCCACT TTATTTCTC TATACAACGA TTTCTCTTG TCACCCTGAAT CTACTTCTG
- CGTGGTGGTG GGGAGGGTGA AATAAAGGAG ATATGTTGCT AAAGGAGAAC AGTGGGACTTA GATGAAGAC

+ CTGCAAAAGG TAATTAGCAT ATCCTAACTA TTTATCACCT CATCCCTCAA GTGTGTTCTTC TACTTTCTT
- GACGTTTTCC ATTAATCGTA TAGGATTGAT AAATAGTGA GTAGGGAGTT CACACAAGAAG ATGAAAGAA
P-box

+ AGATGTACTT TTTAACTTT TCTGTGCATA AACATCTCAT GTGCTGATT CTTTTGTGTGT TCTATGTGC
- TCTACATGAA AAATTTGAAA AGACACGTAT TTGTAGAGTA CACGACTAAG AAAAACACACA AGATACAG

+ TTGCATACCA TGTCGGTTG GTTCGATTG ATTTTTTAAG CATCCGTGTG GTTTGTTTTTG TTCTAGCTT
- AACGTATGGT ACAGGCAAAC CAAGCTAAGC TAAAAAATTC GTAGGCACAC CAAACAAAAAC AAGATCGAA

+ AGCTAGCTAG CTAGCAAAGA GGTGTCATGG ATACATACCA GCTTTAATTT GATTTGGTTTG CTCTACCTT
- TCGATCGATC GATCGTTTCT CCACAGTACC TATGTATGGT CGAAATTAAA CTAAACCAAAC GAGATGGAA
GT1-motif

+ TAAAAGTGTG TGAATCATCT CCGGTCCTAG TTTATGCATA TCTGTGTGCA TATGTACAAAT GTTTCAGGA
- ATTTTCACAC ACTTAGTAGA GGCCAGGATC AAATACGTAT AGACACAGT ATACATGTTTA CAAAGTCCT

+ CAGGAGTTGG CATAACAGCT AACAAATCTT ACATATATAG CAGCAATAAG CAAGGAGCAGT TAGCCAGGT
- GTCCTCAACC GTATTGTCGA TTGTTTAGAA TGTATATATC GTCGTTATTC GTTCTCTGTCA ATCGGTCCA
MBS

+ AAAGCTCTAG CTAGCTAGCT TAGGCAGCA
- TTTCGAGATC GATCGATCGA ATCCGTCGT

Motifs function:

ABRE: cis-acting element involved in the abscisic acid responsiveness

GT1-motif: light responsive element

HSE: cis-acting element involved in heat stress responsiveness

W box

CGTCA-motif: cis-acting regulatory element involved in the MeJA-responsiveness

ERE: ethylene-responsive element

G-Box: cis-acting regulatory element involved in light responsiveness

MBS: MYB binding site involved in drought-inducibility

P-box: Gibberellin-responsive element

TC-rich repeats: cis-acting element involved in defense and stress responsiveness

TCA-element: cis-acting element involved in salicylic acid responsiveness

TGACG-motif: cis-acting regulatory element involved in the MeJA-responsiveness

Circadian: cis-acting regulatory element involved in circadian control