Endoplasmic Reticulum Stress Responses Function in the HRT-mediated Hypersensitive Response in *Nicotiana benthamiana*

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Supporting Information

Table S1 Putative *CaBLP5* homologs identified in *Nicotiana benthamiana*

N. benthamiana* homolog	**bp**	**Annotation**	E-value	Identity
***BiP5* (*Nbv3K685813373*)**	2148	Luminal-binding protein 5 (BiP5), Precursor	0.0	93%
***BiP4* (*Nbv3K645786225*)**	2004	Nicotiana benthamiana ER luminal-binding protein (BLP4)	0.0	89%
Nbv3K645786225	2126	Luminal-binding protein 4 (BiP4), Precursor	0.0	82%
Nbv3K645789686	2203	Luminal-binding protein 5 (BiP 5), Precursor (similar to)	0.0	81%
Nbv3K585690033	1028	Luminal-binding protein 2 (AtBiP2), Precursor	2E-9	83%
Nbv3K585703505	1945	Heat shock cognate 70 kDa protein (similar to)	2E-13	81%
Nbv3K765636570	998	Heat shock cognate 70 kDa protein 2 (similar..to)	2E-10	82%

**CaBLP5* homologs were isolated using BLAST searches in *the N. benthamiana*_transcriptome_v3_ unigenes95 database (http://benth-web-pro-1.ucc.usyd.edu.au/blast/search.php), and retrieved six *CaBLP5* homologs, which have less than 10^{-9} e-value and more than 80% identity with positive orientation.

Table S2 List of oligonucleotide primers used.

Primers	Sequence	Utilization
Actin-F	5'-TGGACTCTGGTGATGGTGTC-3'	RT-PCR
Actin-R	5'-CCTCCAATCCAAACACTGTA-3'	RT-PCR
RAR1-F	*5'-ATGGAGAGACTTCGTTGCCA-3'*	RT-PCR
RAR1-R	*5'-TCTAGGACAAGCTTCTTTCG-3'*	RT-PCR
Actin-F	5'-AGAGGCTACTCTTTTACCACCACGG-3'	qRT-PCR
Actin-R	5'-TGAGCTGGTCTTTGCTGTTTCAAGT-3'	qRT-PCR
HRT-F	5'-TGATGGATTCGCATGGGTCT-3'	qRT-PCR
HRT-R	5'-AGCAGCATCTTCCAACCTCT-3'	qRT-PCR
TCV CP-F	5'-AGCCAAACCTCCGCCCAAC-3'	qRT-PCR
TCV CP-R	5'-CTGATACCATCCGCCACAAAGC-3'	qRT-PCR
HSP90-F	5'-TTCGAGACTGCCCTCCTCACC-3'	qRT-PCR
HSP90-R	5'-TCGTCCTGTTCGGGAGCTTG-3'	qRT-PCR
SGT1-F	5'-GCCAGAGGAGGTGGTGGTGA-3'	qRT-PCR
SGT1-R	5'-AAGTTTCGTCACCCGGCACA-3'	qRT-PCR
Hin1-F	5'-GCCATGCCGGAATCCAATTT-3'	qRT-PCR
Hin1-R	5'-TTGCAGAGGCAGCCAAAGAGA-3'	qRT-PCR
Hsr203J-F	5'-GCTCCGGCGGGAACATAGTC-3'	qRT-PCR
Hsr203J-R	5'-TCCGATAGGACCGCACGAAA-3'	qRT-PCR
NTCP23-F	5'-AGAGACAGGTTGGGGGCAGC-3'	qRT-PCR
NTCP23-R	5'-CAAGATCCGCACTTGCCCTG-3'	qRT-PCR
PR1a-F	5'-GGGACGACCAGGTAGCAGCC-3'	qRT-PCR
PR1a-R	5'-CATTGACCCACATCTCAACGGC-3'	qRT-PCR
PR2-F	5'-TGTTGCTCCTGCCATGCAAA-3'	qRT-PCR
PR2-F	5'-GGGCGGGTTGGTATTCGCTA-3'	qRT-PCR
PR5-F	5'-GGCATGGCTAAGTCAATCCACC-3'	qRT-PCR
PR5-R	5'-GTCTCCGTCGCCACCAGATG-3'	qRT-PCR
CYP71D20-F	5'-AAGGTCCACCGCACCATGTCCTTAGAG-3'	qRT-PCR
CYP71D20-R	5'-AAGAATTCCTTGCCCCTTGAGTACTTGC-3'	qRT-PCR
WRKY8-F	5'-AACAATGGTGCCAATAATGC-3'	qRT-PCR
WRKY8-R	5'-TGCATATCCTGAGAAACCATT-3'	qRT-PCR
bZiP60-F	5'-CCTGCTTTGGTTCATGGGCATCAT-3'	qRT-PCR
bZiP60-R	5'-CACATCACAATTCCCAAATAATG-3	qRT-PCR
Calreticulin-F	5'-TGCTCGTCGCTGTCGTCTCC-3'	qRT-PCR
Calreticulin-R	5'-GCGTCTCCATTCCACTTGCC-3'	qRT-PCR
Beclin1-F	5'-CGTCGTTTTGCCTCCACCAG-3'	qRT-PCR
Beclin1-R	5'-GGAGCATTTTGAGGCCCACC-3'	qRT-PCR
p58^{IPK}-F	5'-CTTGCTGTGGAGGAGTACAAAG-3'	qRT-PCR
p58^{IPK}-R	5'-CTCCCTCCCAATCTTCTGTTAG-3'	qRT-PCR
PR4-F	5'-GGTGTGGGTCTACACCAGAATA-3'	qRT-PCR
PR4-R	5'-CAATTCTCACTGTGGTCTGAGC-3'	qRT-PCR
Nbv3K685813373-F (BiP5)	5'-GTTCAGAGGCAGTGTTCTGT-3'	qRT-PCR
Nbv3K685813373-R (BiP5)	5'-TCTCAGGATTAACAGCAGCC-3'	qRT-PCR
Nbv3K645786225-F (BiP4)	5'-TTTCTCCTCCTTCTACCCCTCT-3'	qRT-PCR
Nbv3K645786225-R (BiP4)	5'- AACGATTGCTAGCACCACCA-3'	qRT-PCR
Nbv3K585690033-F	5'-CTTCACCCTTCTCTCTTCCT-3'	qRT-PCR
Nbv3K585690033-R	5'-CTCGACGTTATTCTCTCCT-3'	qRT-PCR
YFP-F	5'-GAAGCAGCACGACTTCTTCA-3'	qRT-PCR
YFP-R	5'-CGGCCATGATATAGACGTTG-3'	qRT-PCR

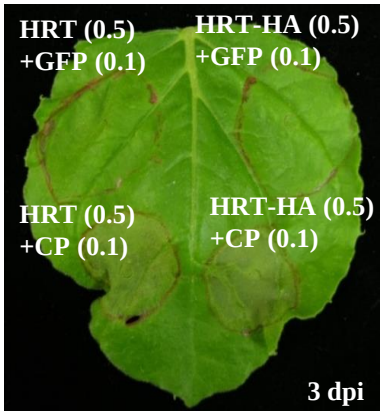

Fig. S1 HA-tagged HRT is functional. Co-expression of *HRT-HA* and *Turnip crinkle virus* (*TCV*) coat protein (CP) induced the hypersensitive response (HR) in *N. benthamiana*. Numbers indicate concentration (OD_{600}) of Agrobacterium cells. The images were photographed 3 days post-infiltration (dpi).

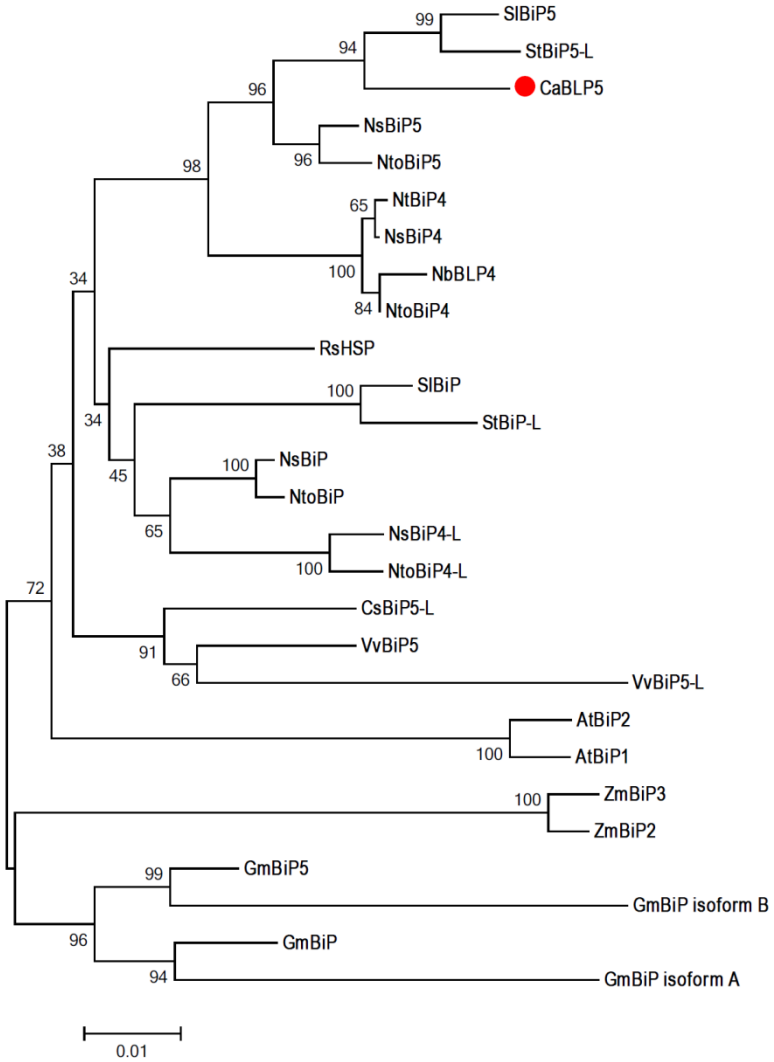

Fig. S2 Phylogenetic analysis of CaBLP5 (GenBank accession No. KC912859) and its homologs. The amino-acid sequences of 26 CaBLP5 homologs were imported into MEGA 6 (Tamura *et al*., 2013) for multiple sequence alignment with ClustalW (Larkin *et a*l., 2007). Phylogenetic analysis was performed using the neighbor-joining (Saitou and Nei., 1987) and bootstrap methods. The bootstrap consensus tree was inferred from 500 replicates. The scale bar indicates the lengths of the branches (relative evolutionary distance). The protein sequences are deposited in GenBank under the following accession numbers: *Solanum lycopersicum* SlBiP5 (XP_004234985.1) and SlBiP (NP_001234636.1), *Solanum tuberosum* StBiP5-L (XP_006350519.1) and StBiP-L (XP_006343810.1), *Nicotiana benthamiana* NbBLP4 (ACK55195.1), *Zea mays* ZmBiP3 (NP_001105894.1) and ZmBiP2 (NP_001105893.1), *Arabidopsis thaliana* AtBiP2 (NP_851119.1) and AtBiP1 (NP_198206.1), *Nicotiana tabacum* NtBiP4 (Q03684.1), *Cucumis sativus* CsBiP5-L (XP_004143862.1), *Vitis vinifera* VvBiP5 (XP_002263323.1) and VvBiP5-L (XP_002276268.2), *Nicotiana sylvestris* NsBiP5 (XP_009773333.1), NsBiP4 (XP_009788736.1), NsBiP (XP_009802727.1), and NsBiP4-L (XP_009770477.1), *Nicotiana tomentosiformis* NtoBiP5 (XP_009592769.1), NtoBiP4 (XP_009588550.1), NtoBiP (XP_009593820.1), and NtoBiP4-L (XP_009619852.1), *Ricinus communis* RsHSP (XP_002518865.1), *Cucumis sativus* CsBiP5-l (XP_004143862.1), and *Glycine max* GmBiP (XP_003525327.2), GmBiP isoform A (NP_001234941.1), and GmBiP isoform B (NP_001238736.1).

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Nbv3K645789686  ------------------------------------------------------------
Nbv3K685813373  ------------------------------------------------------------
NbBLP4          ------------------------------------------------------------
CaBLP5          ------------------------------------------------------------
Nbv3K585690033  ------------------------------------------------------------

Nbv3K585703505  ------------------------------------------------------------
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Nbv3K645786225  AAAATTGTACAAAAAGTGTGAAGAATTTGTTATCTGGGTCTTGAATAA------------ 108
Nbv3K645789686  ------------------------------------------------------------
Nbv3K685813373  ---------CAGAGACTG-GCAACTATATATAGCCGGGCCTTCAATTGCCGAACCTGAAA 50
CaBLP5          -----GGAGAAGAGAAAAAGGAAGAAGATATTGTTCG------------------------ 32
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Nbv3K585703505  ------------------------------------------------------------
Nbv3K765636570  ------------------------------------------------------------
Nbv3K645786225  ------------------------------------------------------------
Nbv3K645789686  ------------------------------------------------------------
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CaBLP5          ------------------------------------------------------------
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Nbv3K645786225  T---------------CTGCACTTTCGATTGCCACAG-AGGAGGCAAACAAACTAGGAAC 235
Nbv3K645789686  ------------------------------------------------------------
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CaBLP5              CCTTACTATTGACAATGGTGTTTTTGAGGTTCTTGCAACAAATGGAGACACTCATCTTGG 831
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Nbv3K585690033      AGGAGAGGATTTTGATCACAGACTAATGGATTATTTCATCAAGTTGATTAAAAGGAAATA 862
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Nbv3K645786225      TGGAAAGGACATCAGCAAAGACAACAGAGCTCTTGGTAAGCTAAGGAGAGAAGCTGAGCG 1027
Nbv3K645789686      TGGAAAGGACATCAGCAAAGACAACAGAGCTCTTGGTAAGCTAAGGAGAGAAGCTGAGCG 758
Nbv3K685813373      TGGAAAGGACATCAGCAAGGATAACAGGGCTTTGGGAAAGCTCAGGAGAGAAGCTGAGCG 1066
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Nbv3K765636570      GGCAAAGAGGACTCTTT-CTTCCACTGCTCAGACCACCATTGAAATTGA---------- 998
Nbv3K645786225      TGCCAAGAGGGCACTGAGTAGCCAGCAC-CAGGTCCGAGTTGAGATTGAATCTCTTTTTG 1086
Nbv3K645789686      TGCCAAGAGGGCACTGAGTAGCCAGCAC-CAGGTCCGAGTTGAGATTGAATCTCTTTTTG 817
Nbv3K685813373      TGCCAAGCGAGCACTGAGCAGTCAGCAT-CAAGTCAGGGTTGAGATTGAATCTCTCTTCG 1125
CaBLP5              AGCCAAGAGAGCCCTGAGCAGTCAGCAT-CAAGTCAGGGTAGAGATTGAGTCTCTCTTCG 1010
Nbv3K585690033      AGCCAAGAGAGCCTTAAGTAACCAGCAC-CAAGTACGCGTTGAAATCGAGTCTCTTTTCG 981
                     ** *** *  *  *       *     **       * ** ** **

Nbv3K585703505      AAGGCATTGATTTTTACTCGACTATTACTAGGGCGAGATTCGAGGAGCTGAACATGGATT 947
Nbv3K765636570      ------------------------------------------------------------
Nbv3K645786225      ATGGTACTGACTTCTCTGAACCATTAACCCGTGCTCGCTTTGAGGAGTTGAACAATGATC 1146
Nbv3K645789686      ATGGTACTGACTTCTCTGAACCATTAACCCGTGCTCGCTTTGAGGAGTTGAACAATGATC 877
Nbv3K685813373      ACGGTGTAGATTTCTCTGAACCACTTACTCGGGCTCGTTTTGAGGAGCTGAACAACGATT 1185
CaBLP5              ATGGTGTGGATTTCTCTGAACCACTTACTCGGGCTCGTTTTGAGGAGCTGAATAATGATT 1070
Nbv3K585690033      ATGGTATTGACTTCTCTGAGCCGTTAACAAGGGCAAGATTCGAGGAA------------- 1028

Nbv3K585703505      TGTTCAGGAAGTGTATGGAGCCAGTGGAGAAGTGTTTGAGAGATGCCAAGATGGATAAAA 1007
Nbv3K765636570      ------------------------------------------------------------
Nbv3K645786225      TCTTCAAAAAGACAATGGGACCTGTGAAGAAGGCAATGGAAGATGCTGGGCTGGAGAAGA 1206
Nbv3K645789686      TCTTCAAAAAGACAATGGGACCTGTGAAGAAGGCAATGGAAGATGCTGGGCTGGAGAAGA 937
Nbv3K685813373      TGTTCAGGAAGACAATGGGTCCTGTTAAGAAGGCTATGGAGGATGCTGGGCTACAAAAGA 1245
CaBLP5              TGTTCCGCAAGACAATGACTCCTGTTAAGAAGGCTATGGATGATGCTGGTGTATCAAAGA 1130
Nbv3K585690033      ------------------------------------------------------------

Nbv3K585703505      CCAGTGTCCATGATGTGGTTCTCGTCGGTGGATCAACTAGGATCCCCAAAGTTCAGCAAT 1067
Nbv3K765636570      ------------------------------------------------------------
Nbv3K645786225      ACCAAATTGATGAGATAGTTCTTGTTGGTGGAAGCACTAGAATTCCAAAAGTGCAACAAC 1266
Nbv3K645789686      ACCAAATTGATGAGATAGTTCTTGTTGGTGGAAGCACTAGAATTCCAAAAGTGCAACAAC 997
Nbv3K685813373      ACCAGATTGACGAAATTGTATTGGTTGGGGGAAGTACCAGGATTCCAAAAGTTCAACAGC 1305
CaBLP5              ACCAGATCGACGAGATTGTCTTGGTTGGTGGAAGTACCAGGATTCCAAAAGTTCAACAGC 1190
Nbv3K585690033      ------------------------------------------------------------
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Nbv3K585703505      TACTTCAAGATTTCTTCAATGGAAAGGAGCTTTGTAAAAGCATCAACCCGGACGAAGCAG 1127
Nbv3K765636570      ------------------------------------------------------------
Nbv3K645786225      TCCTGAAGGACTATTTTGAAGGGAAGGAGCCTAACAAGGGTGTGAATCCTGACGAGGCAG 1326
Nbv3K645789686      TCCTGAAGGACTATTTTGAAGGGAAGGAGCCTAACAAGGGTGTGAATCCTGACGAGGCAG 1057
Nbv3K685813373      TTTTGAAAGATTATTTCGATGGCAAGGAGCCCAACAAGGGTGTCAACCCTGACGAAGCAG 1365
CaBLP5              TTTTGAAAGATTATTTTGATGGCAAGGAGCCCAGCAAGGGTGTCAACCCTGATGAAGCAG 1250
Nbv3K585690033      ------------------------------------------------------------

Nbv3K585703505      TCGCCTATGGTGCAGCTGTCCAAGCTGCAATTTTGAGCGGTGTAGGTAATGAAAAAGTTC 1187
Nbv3K765636570      ------------------------------------------------------------
Nbv3K645786225      TTGCTTATGGTGCTGCTGTCCAAGGTGGTATCTTAAGTGGAGAGGGTGGTGACGAAACTA 1386
Nbv3K645789686      TTGCTTATGGTGCTGCTGTCCAAGGTGGTATCTTAAGTGGAGAGGGTGGTGACGAAACTA 1117
Nbv3K685813373      TTGCTTATGGTGCAGCTGTACAAGGAGGAATCTTGAGTGGAGAGGAGGTGATGAAACCA 1425
CaBLP5              TTGCTTATGGTGCAGCTGTACAAGGAGGAATCTTGAGTGGAGAAGGAGGTGATGAAACCA 1310
Nbv3K585690033      ------------------------------------------------------------

Nbv3K585703505      AAGACTTGTTGCTGTTGGATGTTACTCCTCTGTCTCTTGGTTTAGAAACTGCTGGAGGTG 1247
Nbv3K765636570      ------------------------------------------------------------
Nbv3K645786225      AAGATATCCTTCTCCTGGATGTTGCTCCTCTCACCCTTGGTATTGAAACTGTTGGTGGCG 1446
Nbv3K645789686      AAGATATCCTTCTCCTGGATGTTGCTCCTCTCACCCTTGGTATTGAAACTGTTGGTGGCG 1177
Nbv3K685813373      AAGATATTCTTCTCCTGGATGTTGCTCCATTGACTCTTGGTATTGAAACGGTTGGAGGAG 1485
CaBLP5              AAGATATTCTTCTCTTGGATGTTGCTCCACTGACTCTTGGTATTGAAACTGTTGGAGGAG 1370
Nbv3K585690033      ------------------------------------------------------------

Nbv3K585703505      TAATGACTGTGTTGATACCAAGGAACACAACTATTCCCACCAAGAAAGAGCAAGTGTTCT 1307
Nbv3K765636570      ------------------------------------------------------------
Nbv3K645786225      TGATGACCAAATTGATTCCTAGGAACACTGTCATCCCAACCAAGAAGTCTCAAGTCTTCA 1506
Nbv3K645789686      TGATGACCAAATTGATTCCTAGGAACACTGTCATCCCAACCAAGAAGTCTCAAGTCTTCA 1237
Nbv3K685813373      TGATGACAAAGTTGATCCCAAGGAACACTGTTATTCCTACTAAGAAATCTCAAGTTTTCA 1545
CaBLP5              TGATGACAAAGTTGATCCCAAGAAACACCGTCATTCCTACCAAGAAGTCTCAAGTCTTCA 1430
Nbv3K585690033      ------------------------------------------------------------

Nbv3K585703505      CTACGTACTCGGACAACCAACCTGGTGTGCTGATCCAGGTGTACGAGGGAGAACGAGCCA 1367
Nbv3K765636570      ------------------------------------------------------------
Nbv3K645786225      CTACATACCAAGACCAGCAGACCACTGTCACCATTTCGGTTTATGAAGGAGAAAGGAGTC 1566
Nbv3K645789686      CTACATACCAAGACCAGCAGACCACTGTCACCATTTCGGTTTATGAAGGAGAAAGGAGTC 1297
Nbv3K685813373      CCACTTACCAGGATCAGCAGACAACAGTAACAATTTCGGTCTTTGAAGGTGAACGCAGTC 1605
CaBLP5              CCACTTACCAGGACCAGCAGACAACAGTCACAATTTCGGTCTTCGAAGGTGAACGAAGTA 1490
Nbv3K585690033      ------------------------------------------------------------

Nbv3K585703505      GGACCAAGGACAACAACCTGTTAGGCAAATTTGAACTCTCTGGTATCCCCCCTGCTCCAA 1427
Nbv3K765636570      ------------------------------------------------------------
Nbv3K645786225      TTACTAAGGACTGCAGGCTCCTTGGAAATTTTGATCTGACCGGAATTCCTCCAGCTCCAA 1626
Nbv3K645789686      TTACTAAGGACTGCAGGCTCCTTGGAAATTTTGATCTGACCGGAATTCCTCCAGCTCCAA 1357
Nbv3K685813373      TCACCAAGGACTGCAGGCTACTTGGGAAATTTGACTTAACTGGAATAGCTCCAGCTCCAA 1665
CaBLP5              TGGTAAAGGACTGTAGACTGCTCGGTAAATTCGACTTAACAGGAATACCTCCAGCTCCAA 1550
Nbv3K585690033      ------------------------------------------------------------
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Nbv3K585703505      GGGGTGTTCCTCAAATCAATGTCTGCTTTGACATTGATGCCAATGGCATTCTCAATGTTT 1487
Nbv3K765636570      ------------------------------------------------------------
Nbv3K645786225      GGGGAACACCTCAAATTGAGGTTACCTTTGAAGTTGATGCAAACGGTATTTTGAATGTCA 1686
Nbv3K645789686      GGGGAACACCTCAAATTGAGGTTACCTTTGAAGTTGATGCAAACGGTATTTTGAATGTCA 1417
Nbv3K685813373      GAGGAACTCCTCAAATTGAAGTTACGTTTGAGGTTGATGCCAACGGTATCCTGAATGTGA 1725
CaBLP5              GAGGAACACCTCAAATTGAAGTTACTTTTGAGGTCGATGCCAACGGTATCTTGAACGTGA 1610
Nbv3K585690033      ------------------------------------------------------------

Nbv3K585703505      CTGCCGAGGACAAAACTACTGGTCAGAAGAACAAGATAACGATCACCAACGACAAAGGCC 1547
Nbv3K765636570      ------------------------------------------------------------
Nbv3K645786225      AAGCAGAAGATAAGGGCACTGGTAAATCAGAGAAGATTACCATTACAAATGACAAGGGCC 1746
Nbv3K645789686      AAGCAGAAGATAAGGGCACTGGTAAATCAGAGAAGATTACCATTACAAATGACAAGGGCC 1477
Nbv3K685813373      AAGCGGAAGATAAAGCCTCTGGAAAGTCAGAGAAGATCACCATTACCAATGATAAGGGTC 1785
CaBLP5              AAGCTGAGGACAAAGCCTCTGGAAAGTCGGAAAAGATTACAATCACTAATGACAAGGGTC 1670
Nbv3K585690033      ------------------------------------------------------------

Nbv3K585703505      GGCTCTCCAAGGAAGAGATTGAGAGAATGGTGCAAGAAGCTGAGAAGTACAAGTCTGAAG 1607
Nbv3K765636570      ------------------------------------------------------------
Nbv3K645786225      GCTTAAGCCAAGAAGAGATTGAACGAATGGTTCGTGAAGCAGAAGAGTTTGCCGAGGAAG 1806
Nbv3K645789686      GCTTAAGCCAAGAAGAGATTGAACGAATGGTTCGTGAAGCAGAAGAGTTTGCCGAGGAAG 1537
Nbv3K685813373      GCTTGAGTCAAGAAGAAATTGAACGTATGGTCAAGGAGGCTGAGGAGTTTGCTGAGGAGG 1845
CaBLP5              GCTTGAGTCAAGAAGAAATTGAACGTATGGTGAAGGAGGCTGAGGAGTTTGCTGAGGAGG 1730
Nbv3K585690033      ------------------------------------------------------------

Nbv3K585703505      ATGAAGAGCTTAAGAAAAAAGTGGAAGCTAAGAATGCCTTGGAGAATTACGCTTACAACA 1667
Nbv3K765636570      ------------------------------------------------------------
Nbv3K645786225      ACAAGAAGGTGAAGGAGAGGATTGACGCCCGTAATGGTCTTGAAACCTATGTGTACAACA 1866
Nbv3K645789686      ACAAGAAGGTGAAGGAGAGGATTGACGCCCGTAATGGTCTTGAAACCTATGTGTACAACA 1597
Nbv3K685813373      ACAAGAAGGTGAAAGAACGAATTGACGCGCGAAACAGCCTGGAGACTTACGTGTACAACA 1905
CaBLP5              ACAAGAAGGTGAAAGAAAGAGTTGACGCCCGAAACAGCCTGGAGACATACGTATACAACA 1790
Nbv3K585690033      ------------------------------------------------------------

Nbv3K585703505      TGAGGAATACAATCAAAGAT---GACAAGATTAGCTCCCAACTACCGGCTGCTGATAGGA 1724
Nbv3K765636570      ------------------------------------------------------------
Nbv3K645786225      TGAAAAACCAGATTAACGACAAGGACAAGCTTGCTGACAAGCTCGAGGTCGATGAGAAGG 1926
Nbv3K645789686      TGAAAAACCAGATTAACGACAAGGACAAGCTTGCTGACAAGCTCGAGGTCGATGAGAAGG 1657
Nbv3K685813373      TGAGGAACCAAATCAATGACAAGGATAAACTTGCAGACAAGTTAGAGTCTGATGAGAAAG 1965
CaBLP5              TGAGGAACCAAATCAATGACAAGGACAAACTTGCAGACAAGTTAGAGTCTGACGAGAAGG 1850
Nbv3K585690033      ------------------------------------------------------------

Nbv3K585703505      AGAAGATTGAGGACGCAATTGATGAAGCTATCAAGTGGCTGGACAGCAACCAACTTGCAG 1784
Nbv3K765636570      ------------------------------------------------------------
Nbv3K645786225      AGAAGATTGAGACTGCCGTAAAGGAAGCCCTCGAGTGGCTGGATGACAACCAAAGTGCTG 1986
Nbv3K645789686      AGAAGATTGAGACTGCCGTAAAGGAAGCCCTCGAGTGGCTGGATGACAACCAAAGTGCTG 1717
Nbv3K685813373      AGAAGATTGAAACAGCCACAAAAGAAGCACTTGAATGGTTGGACGACAACCAGAGCGCTG 2025
CaBLP5              AGAAGATTGAAACAGCCACAAAAGAAGCACTTGACTGGTTGGACGACAACCAGAGTGCTG 1910
Nbv3K585690033      ------------------------------------------------------------
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Nbv3K585703505      AGGTGGATGAATTTGAAGACAAGATGAAGGAGCTGGAAGGTATCTGCAATCCAATCATTG 1844
Nbv3K765636570      ------------------------------------------------------------
Nbv3K645786225      AGAAAGAGGACTACGAGGAGAAGCTGAAAGAGGTCGAGGCAGTATGCAACCCAATCATCA 2046
Nbv3K645789686      AGAAAGAGGACTACGAGGAGAAGCTGAAAGAGGTCGAGGCAGTATGCAACCCAATCATCA 1777
Nbv3K685813373      AGAAGGAGGATTATGATGAAAAACTGAAAGAAGTGGAGGCTGTGTGCAACCCAATTATCA 2085
CaBLP5              AGAAGGAGGATTACGACGAGAAGCTGAAAGAAGTTGAGGCAGTGTGCAACCCAATTATCA 1970
Nbv3K585690033      ------------------------------------------------------------

Nbv3K585703505      CTAAGATGTATCAAGGTGGTGCTGGTGGAGCTACTATGGATGAAGATGGTCCTTCTGTTG 1904
Nbv3K765636570      ------------------------------------------------------------
Nbv3K645786225      CAGCTGTTTATCAACGAT---CAGGTGGAGCCCCAAGTGGTT----------------CA 2087
Nbv3K645789686      CAGCTGTTTATCAACGAT---CAGGTGGAGCCCCAAGTGGTT----------------CA 1818
Nbv3K685813373      CGGCTGTGTATCAGAGAT---CTGGTGGAGCCCCAGGAGG------------------TG 2124
CaBLP5              CGGCTGTGTATCAGAGGT---CTGGTGGAGCCCCAGGAGGTGCCA------GTGAGGATT 2021
Nbv3K585690033      ------------------------------------------------------------

Nbv3K585703505      CTGGCGGAGCTGGAAACGGAAGTGGTGCTGGACCGAAGATT-------------------- 1945
Nbv3K765636570      ------------------------------------------------------------
Nbv3K645786225      TCAGCAGAA--GAAGAAGATGGACATGATGAACTGTAGGTT-------------------- 2126
Nbv3K645789686      TCAGCAGAA--GAAGAAGATGGACATGATGAACTGTAGGTTAAACTTAACACTTCCATTG 1876
Nbv3K685813373      CCAG---------------------------------------------------------- 2128
CaBLP5              CCAAC-GAT--GATGACGATTCACACGACGAGCTGTGATGGAATTTCTAGGTTTTGTTAG 2078
Nbv3K585690033      ------------------------------------------------------------

Nbv3K585703505      ------------------------------------------------------------
Nbv3K765636570      ------------------------------------------------------------
Nbv3K645786225      ------------------------------------------------------------
Nbv3K645789686      ACGCTGCTGAAAAGAGGCAAAACAAGAGGATACAGGTAGACCAAGGCGAGTTTAGTGTAA 1936
Nbv3K685813373      ------------------------------------------------------------
CaBLP5              TTTTCTCTTCCCAAATAGAAGATAAGAATACACTTCTG-------------CTGTTATGA 2125
Nbv3K585690033      ------------------------------------------------------------

Nbv3K585703505      ------------------------------------------------------------
Nbv3K765636570      ------------------------------------------------------------
Nbv3K645786225      ------------------------------------------------------------
Nbv3K645789686      GTTGTAAGTTTTGTCATTGTTTAAGTACGAGGGAAGAGGTATCCCTTCGCTTGGTCTTTT 1996
Nbv3K685813373      ------------------------------------------------------------
CaBLP5              TTTCTAAAATGTAATATCACC---GTATGAAGGGTGGAACGTAGAACAACTTGGAAGAAA 2182
Nbv3K585690033      ------------------------------------------------------------

Nbv3K585703505      ------------------------------------------------------------
Nbv3K765636570      ------------------------------------------------------------
Nbv3K645786225      ------------------------------------------------------------
Nbv3K645789686      GAGGTGAAGATACTTTTGAAAGGACGTTTTCTCGTTTAAACTTGTATTCTGCTTCGATCT 2056
Nbv3K685813373      ------------------------------------------------------------
CaBLP5              CCGTGAGGGAGGGATGTGTAATGTCGCTCTGGTCT----------------CTTTCCGCT 2226
Nbv3K585690033      ------------------------------------------------------------
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Nbv3K585703505      ------------------------------------------------------------
Nbv3K765636570      ------------------------------------------------------------
Nbv3K645786225      ------------------------------------------------------------
Nbv3K645789686      GTTTTAGAACTTCTGAGATTAGTTGAATCTAACGGAATCAAATTCAGAATGAAGTTTAAC 2116
Nbv3K685813373      ------------------------------------------------------------
CaBLP5              GGTTCATTTTTTCCCCGTACACCTGTATAGGCGACATTTAATTCAGAGTTCAAATTTCTT 2286
Nbv3K585690033      ------------------------------------------------------------

Nbv3K585703505      ------------------------------------------------------------
Nbv3K765636570      ------------------------------------------------------------
Nbv3K645786225      ------------------------------------------------------------
Nbv3K645789686      ATGCCAAGTTTCCATTTTGCTATCAGTTGTAATGTCCTTTTTCCATCAGTTGTTTTTATA 2176
Nbv3K685813373      ------------------------------------------------------------
CaBLP5              GTATTCATTTGTCTGTGGGTTGTTTTATCTTTTAAGGCTTGTCGCCAAGCAAAGAGTAAG 2346
Nbv3K585690033      ------------------------------------------------------------

Nbv3K585703505      ---------------------------
Nbv3K765636570      ---------------------------
Nbv3K645786225      ---------------------------
Nbv3K645789686      ATAACAACTCTTATCAGCATCAAGCTC 2203
Nbv3K685813373      ---------------------------
CaBLP5              GCTATAAGTCAAAAAAAAAGCGGCCGC 2373
Nbv3K585690033      ---------------------------
```

Fig. S3 Multiple sequence alignment of the CaBLP5 and six *N. benthamiana* BiP genes with Clustal 2.1. The asterisks at the bottom line of the alignment indicate identical residues in a given sequence position. Within the aligned sequences, the dashes indicate the gaps that were inserted in order to optimize the alignment. The CaBLP5 nucleotide sequences in red color used for *Tobacco rattle virus* (TRV)2-*CaBLP5* construct. Residues underlined red represent gene-specific primer sequences used for detecting each gene expression in *GFP*- or *CaBLP5*-silenced plants. Residues in turquoise indicate stretches of more than 21 nucleotides (Liu *et al.*, 2002) that is identical between TRV2-*CaBLP5* and the corresponding *NbBiP* homologs. Note that TRV2-*CaBLP5* contains a stretch of 21 nucleotides of 100% identity with *Nbv3K645786225* and *Nbv3K645789686* and multiple 21-nucleotide stretches of 100% identity with *Nbv3K685813373*, while no stretches of 21 nucleotides with perfect matches to other *BiP* homologs.

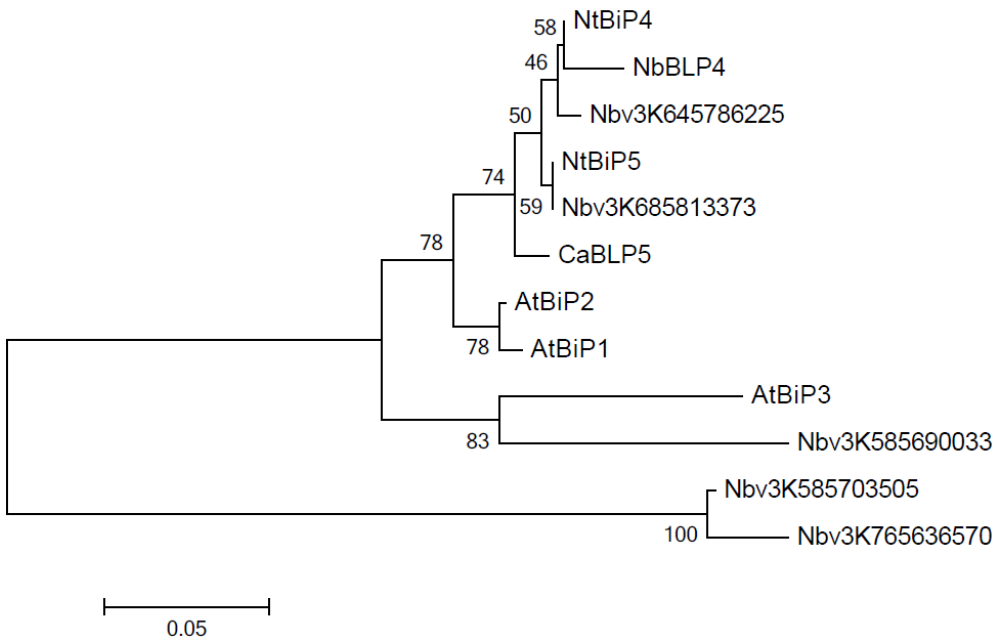

Fig. S4 Phylogenetic analysis of CaBLP5 and its tobacco, and *Arabidopsis* homologs. The amino acid sequences of 11 CaBLP5 homologs were imported into MEGA 6 for multiple sequence alignment with ClustalW. Phylogenetic analysis was performed using the neighbor-joining and bootstrap methods. The bootstrap consensus tree was inferred from 500 replicates. The scale bar indicates the lengths of the branches (relative evolutionary distance). GenBank accession numbers for the homolog protein are mentioned in legend of Fig. S2.

```
Nbv3K685813373      MAG-AWKRRASLVVFAIVLFGSLFAFSIAKEEATKLGTVIGIDLGTTYSCVGVYKNGHVE 59
CaBLP5              MAA-AWKTRASLTVFAIVLFGSLFAFSIAKEEATKLGTVIGIDLGTTYSCVGVYKNGHVE 59
NbBLP4              MAGGAWNRRASLIVFGIVLFGCLFAFSIATEEATKLGTVIGIDLGTTYSCVGVYKNGHVE 60
Nbv3K645786225      MGGGYWRRSSSLVVLAIVLFGCLSALSIATEEANKLGTVIGIDLGTTYSCVGVYKNGHVE 60

Nbv3K685813373      IIANDQGNRITPSWVAFTDGERLIGEAAKNQAAVNPERTIFDVKRLIGRKFDDKEVQRDK 119
CaBLP5              IIANDQGNRITPSWVAFTDGERLIGEAAKNQAAVNPERTIFDVKRLIGRKFDDKEVQRDM 119
NbBLP4              IIANDQGNRITPSWVAFTDGERLIGEAAKNLAAVNPERTIFDVKRLIGRKFDDKEVQRDM 120
Nbv3K645786225      IIANDQGNRITPSWVGFTDGERLIGEAAKNQAAVNPERTIFDVKRLIGRKFEDKEVQRDM 120

Nbv3K685813373      KLVPYEIVNKDGKPYIQVKIKDGETKVFSPEEISAMILTKMKETAEAYLGKKIKDAVVTV 179
CaBLP5              KLVPYKIVNKDGKPYIQVKVKDGETKVFSPEEISAMILTKMKETAEAYLGKTIKDAVVTV 179
NbBLP4              KLVPYKIVNKDGKPYIQVKIKDGETKVFSPEEISAMILTKMKETAEAYLGKKIKDAVVTV 180
Nbv3K645786225      KLVPYKIVNKDGKPYIQVKIKDGEVKVFSPEEISAMILIKMKETAEAFLGKKIKDAVVTV 180
                    *****:**********:****.********** ********:***.********

Nbv3K685813373      PAYFNDAQRQATKDAGVIAGLNVARIINEPTAAAIAYGLDKKGGEKNILVFDLGGGTFDV 239
CaBLP5              PAYFNDAQRQATKDAGVIAGLNVARIINEPTAAAIAYGLDKKGGEKNILVFDLGGGTFDV 239
NbBLP4              PAYFNDAQRQATKDAGVIAGLNVARIINEPTAAAIAYGLDKKGGEKSILVFDLGGGTFDV 240
Nbv3K645786225      PAYFNDAQRQATKDAGVIAGLNVARIINEPTAAAIAYGLDKKGGEKNILVFDLGGGTFDV 240
                    **********************************************.**************

Nbv3K685813373      SILTIDNGVFEVLATNGDTHLGGEDFDQRIMEYFIKLIKKKHGKDISKDNRALGKLRREA 299
CaBLP5              SILTIDNGVFEVLATNGDTHLGGEDFDQRVMEYFIKLIKKKHGKDISKDNKALGKLRREA 299
NbBLP4              SILTIDNGVFEVLSTNGDTHLGGEDFDQRIMEYFIKLIMKKHGKDISKDNRALGKLRREA 300
Nbv3K645786225      SVLTIDNGVFEVLSTNGDTHLGGEDFDQRIMEYFIKLIKKKHGKDISKDNRALGKLRREA 300
                    *:***********:***************:******** ***********:*********

Nbv3K685813373      ERAKRALSSQHQVRVEIESLFDGVDFSEPLTRARFEELNNDLFRKTMGPVKKAMEDAGLQ 359
CaBLP5              ERAKRALSSQHQVRVEIESLFDGVDFSEPLTRARFEELNNDLFRKTMTPVKKAMDDAGVS 359
NbBLP4              ERAKRALSSQHQVRVEIESFFDGVDFSEPLTRARFEELNNDLFRKTMGPVKKAMDDAGLE 360
Nbv3K645786225      ERAKRALSSQHQVRVEIESLFDGTDFSEPLTRARFEELNNDLFKKTMGPVKKAMEDAGLE 360
                    ******************:***.******************:*** ******:***:.

Nbv3K685813373      KNQIDEIVLVGGSTRIPKVQQLLKDYFDGKEPNKGVNPDEAVAYGAAVQGGILSGEGGDE 419
CaBLP5              KNQIDEIVLVGGSTRIPKVQQLLKDYFDGKEPSKGVNPDEAVAYGAAVQGGILSGEGGDE 419
NbBLP4              KTQIDEIVLVGGSTRIPKVQQLLKDYFDGKEPNKGVNPDEAVAYGAAVQGGILSGEGGDE 420
Nbv3K645786225      KNQIDEIVLVGGSTRIPKVQQLLKDYFEGKEPNKGVNPDEAVAYGAAVQGGILSGEGGDE 420
                    *.*************************:****.**************************

Nbv3K685813373      TKDILLLDVAPLTLGIETVGGVMTKLIPRNTVIPTKKSQVFTTYQDQQTTVTISVFEGER 479
CaBLP5              TKDILLLDVAPLTLGIETVGGVMTKLIPRNTVIPTKKSQVFTTYQDQQTTVTISVFEGER 479
NbBLP4              TKDILLLDVAPLTLGIETVGGVMTKLIPRNTVIPSKKSQVFTTYQDQQTTVTIQVFEGER 480
Nbv3K645786225      TKDILLLDVAPLTLGIETVGGVMTKLIPRNTVIPTKKSQVFTTYQDQQTTVTISVYEGER 480
                    **********************************:******************.*:****
Nbv3K685813373      SLTKDCRLLGKFDLTGIAPAPRGTPQIEVTFEVDANGILNVKAEDKASGKSEKITITNDK 539
CaBLP5              SMVKDCRLLGKFDLTGIPPAPRGTPQIEVTFEVDANGILNVKAEDKASGKSEKITITNDK 539
NbBLP4              SLTKDCRLLGKFDLTGIAPAPRGTPQIEVTFEVDANGILNVKAEDKASGKSEKITITNDK 540
Nbv3K645786225      SLTKDCRLLGNFDLTGIPPAPRGTPQIEVTFEVDANGILNVKAEDKGTGKSEKITITNDK 540
                    *:.*******:******.****************************.:************

Nbv3K685813373      GRLSQEEIERMVKEAEEFAEEDKKVKERIDARNSLETYVYNMRNQINDKDKLADKLESDE 599
CaBLP5              GRLSQEEIERMVKEAEEFAEEDKKVKERVDARNSLETYVYNMRNQINDKDKLADKLESDE 599
NbBLP4              GRLSQEEIERMVKEAEEFAEEDKKVKERIDARNSLETYVYNMRNQINDKDKLADKLESDE 600
Nbv3K645786225      GRLSQEEIERMVREAEEFAEEDKKVKERIDARNGLETYVYNMKNQINDKDKLADKLEVDE 600
                    ************:***************:****.********:*************** **

Nbv3K685813373      SLTKDCRLLGKFDLTGIAPAPRGTPQIEVTFEVDANGILNVKAEDKASGKSEKITITNDK 539
CaBLP5              SMVKDCRLLGKFDLTGIPPAPRGTPQIEVTFEVDANGILNVKAEDKASGKSEKITITNDK 539
NbBLP4              SLTKDCRLLGKFDLTGIAPAPRGTPQIEVTFEVDANGILNVKAEDKASGKSEKITITNDK 540
Nbv3K645786225      SLTKDCRLLGNFDLTGIPPAPRGTPQIEVTFEVDANGILNVKAEDKGTGKSEKITITNDK 540
                    *:.*******:******.****************************.:************
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Nbv3K685813373      GRLSQEEIERMVKEAEEFAEEDKKVKERIDARNSLETYVYNMRNQINDKDKLADKLESDE 599
CaBLP5              GRLSQEEIERMVKEAEEFAEEDKKVKERVDARNSLETYVYNMRNQINDKDKLADKLESDE 599
NbBLP4              GRLSQEEIERMVKEAEEFAEEDKKVKERIDARNSLETYVYNMRNQINDKDKLADKLESDE 600
Nbv3K645786225      GRLSQEEIERMVREAEEFAEEDKKVKERIDARNGLETYVYNMKNQINDKDKLADKLEVDE 600
                    ************:***************:****.********:************** **

Nbv3K685813373      KEKIETATKEALEWLDDNQSAEKEDYDEKLKEVEAVCNPIITAVYQRSGGAPGGA----- 654
CaBLP5              KEKIETATKEALDWLDDNQSAEKEDYDEKLKEVEAVCNPIITAVYQRSGGAPGGASEDSN 659
NbBLP4              KEKIETATKEALEWLDDNQSAEKEDYEEKLKEVEAVCNPIITAVYQKSGGAPGGESGASE 660
Nbv3K645786225      KEKIETAVKEALEWLDDNQSAEKEDYEEKLKEVEAVCNPIITAVYQRSGGAPSGS---SA 657
                    *******.****:*************:******************:*****.*

Nbv3K685813373      ---------
CaBLP5              DDDDSHDEL 668
NbBLP4              DDD--HDEL 667
Nbv3K645786225      EEEDGHDEL 666
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Fig. S5 Putative amino acid sequence alignment of the CaBLP5 (AGS42239) and its *N. benthamiana* homologs. The amino-acid sequences of three CaBLP5 homologs were aligned with ClustalW. The asterisks at the bottom line of the alignment indicate identical residues in a given sequence position, while single and double dots refer to highly and moderately conserved residues, respectively. Within the aligned sequences, the dashes indicate the gaps that were inserted in order to optimize the alignment.

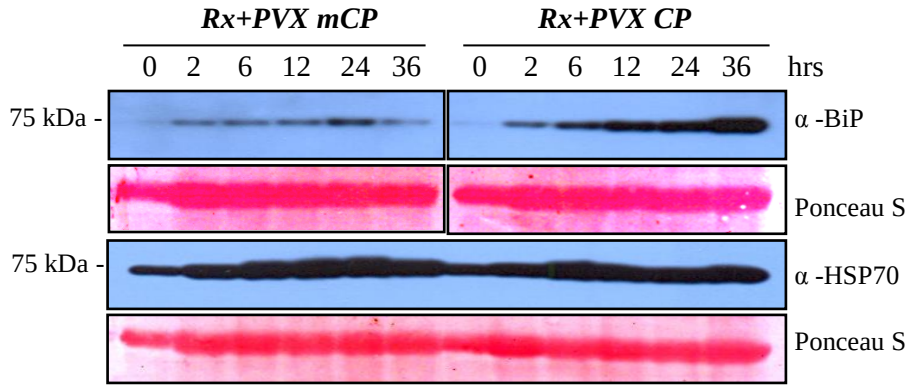

Fig. S6 BiP was promoted at protein level by induction of the Rx-mediated HR. *Rx* and mutant PVX *CP (PVX mCP)* or wild type of PVX *CP* (*PVX CP*) were co-expressed in leaves of *N. benthamiana*, respectively. Total protein was extracted from *N. benthamiana* leaves expressing the indicated proteins at the designated time points and analyzed by immunoblotting with anti-BiP or -cytosolic heat shock protein (HSP) 70 antibodies. Ponceau S staining of Rubisco.was used for loading control.

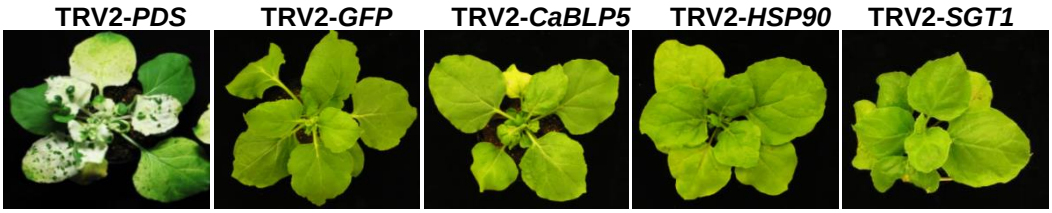

Fig. S7 Morphological phenotype of the *CaBLP5*-VIGS *N. benthamiana* plant. *GFP*- and *PDS*- silenced plants were used as negative and positive reference for the VIGS experiment. The silenced plants were photographed at 21 dpi.

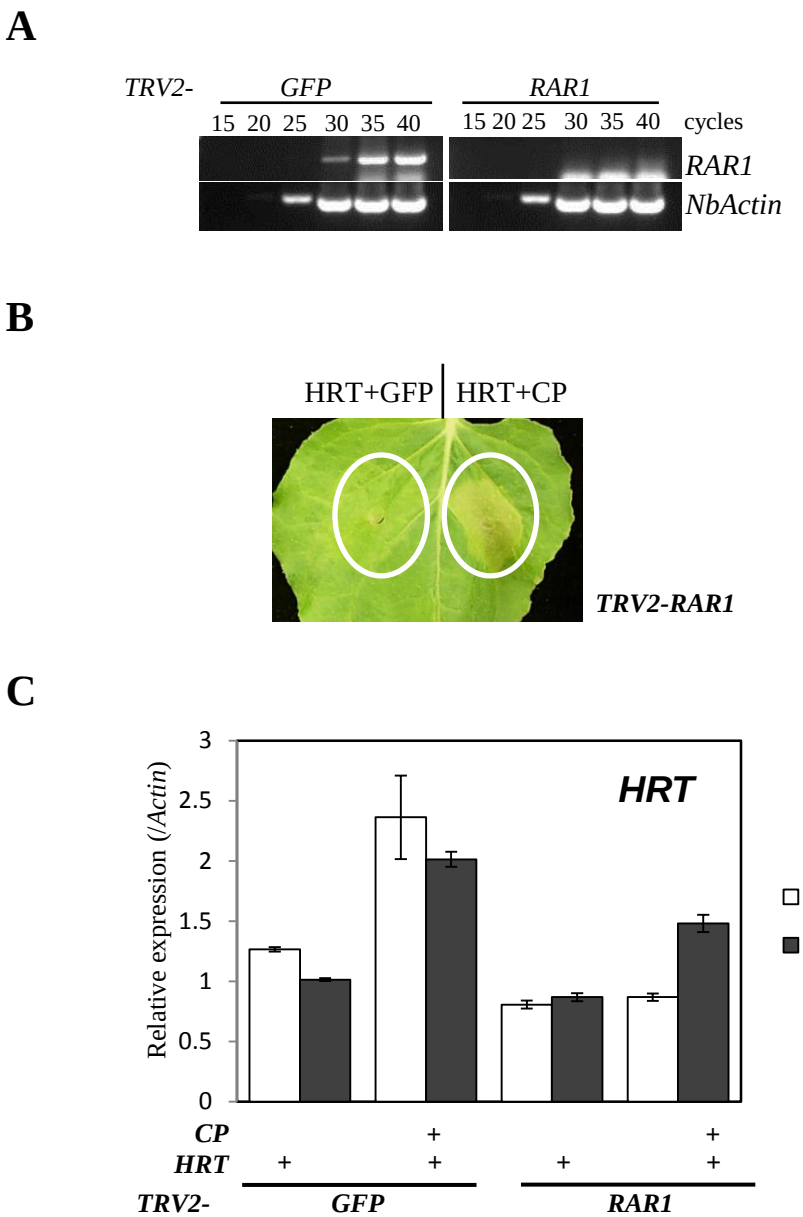

Fig. S8 Silencing of *RAR1*. (A) Reverse transcription PCR analysis was performed to assess the efficiency of gene silencing. Primer directed to gene specific, or *NbActin*, with use of equal amount of cDNA from silenced plants. Numbers indicate PCR cycles. (B) HRT/CP-mediated HR induction on the leaves of the RAR1-silenced plants. (C) Transcriptional levels of the *HRT* in *GFP*- or *RAR1*-silenced plant. The values were normalized to the expression of *NbActin*. Error bars represent SD (n = 3). Means with the same letter are not significantly different (t test, P value < 0.001).

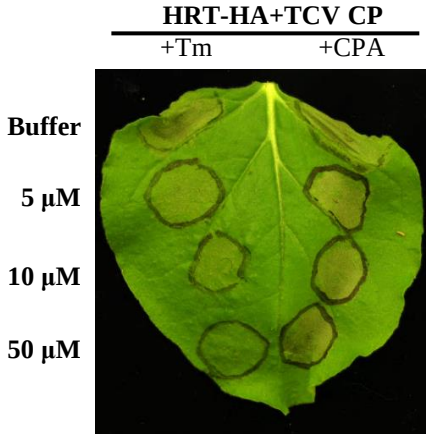

Fig. S9 Effect of Tunicamycin (Tm) on cell death by co-expression of HRT/TCV CP. Endoplasmic reticulum (ER) stress-inducing chemical TM was co-infiltrated as indicated concentrations, and infiltration buffer was used as refernce. Pictures were taken 3 dpi.

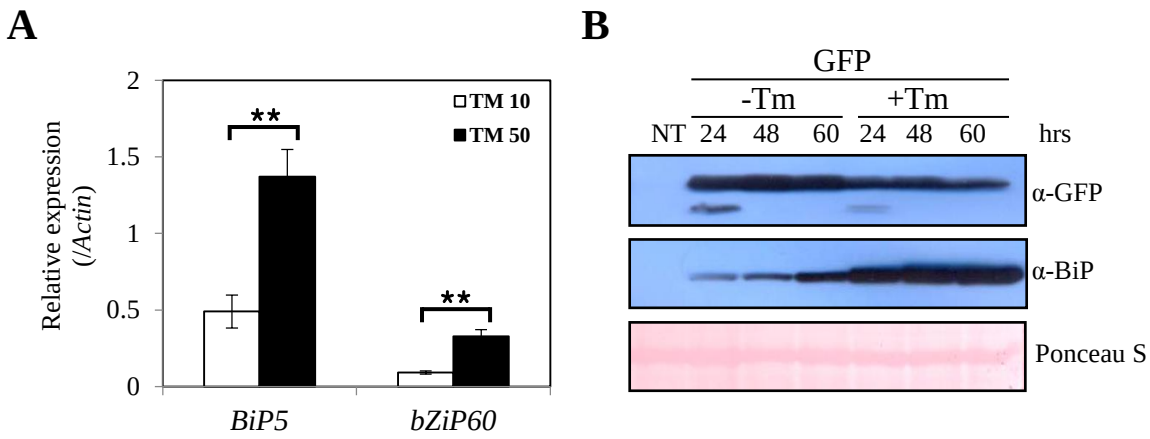

Fig. S10 Triggering the unfolded protein response (UPR) pathway by Tm treatment. (A) Expression of *BiP5* and *bZiP60* in TRV2-*GFP*-infected plants by qRT-PCR. Error bars present standard error of three replicates. Asterisks indicate a significant difference from corresponding control (Student's *t*-test, $^{**}P < 0.005$). Tm 10, 10 μM Tm; Tm 50, 50 μM Tm. (B) Effects of Tm treatment on levels of BiP proteins. Total protein was prepared at the indicated time points (hrs). BiP and GFP proteins were detected using anti-BiP and anti-GFP antibodies.

References

Larkin, M.A., Blackshields, G., Brown, N. P., Chenna, R., McGettigan, P. A., McWilliam, H., Valentin, F., Wallace, I. M., Wilm, A., Lopez, R., Thompson, J. D., Gibson, T. J., and Higgins, D. G. (2007) Clustal W and Clustal X version 2.0. Bioinformatics, 23, 2947–2948.

Liu, Y., Schiff, M. and Dinesh-Kumar, S. P. (2002) Virus-induced gene silencing in tomato. Plant J., 31, 777-786.

Saitou, N. and Nei, M. (1987) The neighbor-joining method: a new method for reconstructing phylogenetic trees. Mol. Biol. Evol. 4, 406–425.

Tamura, K., Stecher, G., Peterson, D., Filipski, A. and Kumar, S. (2013) MEGA6: Molecular Evolutionary Genetics Analysis version 6.0. Mol. Biol. Evol., 30,:2725–2729.