

Supplementary Materials:

(A)

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TOC1      1  ATGGATTGAACGGTGAGTGTAAAGGAGGAG-----ATGGGTTTATTGATAGAAGCAGAGTCAGGATTTTGCTTTGTGACAAATGATCCACGAGTTGGGAGAGGTTTTTACTCTCCTT
BrPRR1b   1  ATGGATTGAACGGTGAGTGTAAAGGAGGAG-----ATGGGTTTATTGACAGAAGCAGAGTTAGGATTTGCTTTGTGACAAATGATCCACGAGCTGGGAGATGTTTTACCCCTCCTT
BrPRR1a    1  ATGGATTGAACGGAGAGTGTAAAGGAGGAGGAGATGGGTTTATTGACAGAAGCAGAGTTAGGATTTGCTTTGTGACAAATGATCCCAATAGCTTGGGAGAGGTTTTACCCCTCCTT
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TOC1      121 TCACAGTGTCTTATCAAGTGACTGCAATGAAATCAGCAAGGCAGGTGATGATGCACTTAATGCAGAGGGACCTGATATCGATATAATACTGGCGAAATGATCTCCCAATGGCTAAG
BrPRR1b    121 TCACAGTGTCTTATCAAGTGACTGCAATGAAATCAGCAAGGCAGGTGATGATGCACTTAATGCAGAGGGACCTGATATCGATATAATACTGGCGAAATGATCTCCCAATGGCTAAG
BrPRR1a    121 TCACAGTGTCTTATCAAGTGACTGCAATGAAATCAGCAAGGCAGGTGATGATGCACTTAATGCAGAGGGACCTGATATCGATATAATACTGGCGAGATTGATCTCCCAATGGCTAAG
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TOC1      241 GGTATGAAGATGCTGAGGTACATCACACGAGACAAAGATCTTCGCAAGATCCCTGTGATATGATGTCGAGGCAAGACGAGTACCTGCTGCTGTAAGTGTGTAAGCTAGGTGCAGCT
BrPRR1b    241 GGTATGAAGATGCTGAGGTACATCACACGAGTACGCAAGATCTTCGCAAGATCCCTGTGATATGATGTCGAGGCAAGACGAGTACCTGCTGCTGTAAGTGTGTAAGCTAGGTGCAGCT
BrPRR1a    241 GGTATGAAGATGCTAAGGTACATCACACGAGTACGCAAGATCTTCGCAAGATCCCTGTGATATGATGTCGAGGCAAGACGAGTACCTGCTGCTGTAAGTGTGTAAGCTAGGTGCAGCT
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TOC1      361 GACTACCTTGTGAAGCCTCTTCGCACCAACGAGCTTCTGAACCTTGTGGACACACATGTGGAGAAGAGCGCATGCTAGGACTTGCTGAGAAATATGTTGAGCTATGATTTTATCTT
BrPRR1b    361 GACTACCTTGTGAAGCCTCTTCGCACCAACGAGCTTCTGAACCTTGTGGACACACATGTGGAGAAGAGCGCATGCTAGGACTTGCTGAGAAATATGTTGAGCTATGATTTTATCTT
BrPRR1a    361 GACTACCTTGTGAAGCCTCTTCGCACCAACGAGCTTCTGAACCTTGTGGACACACATGTGGAGAAGAGCGCATGCTAGGACTTGCTGAGAAATATGTTGAGCTATGATTTTATCTT
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TOC1      481 GTGGGATCTGATCAAAAGTATCCAAACACAAATAGTACCAACCTGTTCTCTGACGACAGATGATAGAAGTCTTAGTCCACCAACCAAGAGAGAAATTAAGTCAACGAGGAAAT
BrPRR1b    481 GTGGGATCTGATCAAAAGTATCCAAACACAAAGTATCCAAACCTGTTCTCTGATGACACTGATGACAGAGTATCAGGTCCACCAACCCGCTGAGAGGACCTTTAAGCCGTCAGGAAAAA
BrPRR1a    481 GTGGGATCTGATCAAAAGTATCCAAATACAAACAGCACCAACCTGTTCTCTGATGACAGATGAGAGAAGTATTAGTCCACCAATCCGAGAGAG-----GAAGTCATCAGGAAAG
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TOC1      501 GAGTGGTCTGTGCTACTGCTCTGTTCAATGCTGCTGATGGTGGTCTGGTCTGATGGAACAGCCACTTCTCTCTGCTGTTACTGCTGCTATAGAGCCTCCATTGGATCATCTTCTGCTGG
BrPRR1b    501 GAGTGGTCTGTGCTACTGCTCTGTTCAATGCTGCTGATGGTGGTCTGGTCTGATGGAACAGCCACTTCTCTCTGCTGTTACTGCTGCTGCTATAGAGCCTCCATTGGATCATCTTCTGCTGG
BrPRR1a    501 GAGTGGTCTGTGCTACTGCTCTGTTCAATGCTGCTGATGGTGGTCTGGTCTGATGGAACAGCCACTTCTCTCTGCTGTTACTGCTGCTGCTATAGAGCCTCCATTGGATCATCTTCTGCTGG
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TOC1      621 TCTCACCATGAGCCAAATGAAAGAAATAGTAAATCCAGCGCAATTTTCTCAGCAGCGAAGAAAGATAGATTGAAGATCGGAGAGTCTCTGCTTTCTTTACATATGTCAAATCTACTGTG
BrPRR1b    621 TCTCACCATGAGCCAAATGAAAGAAATAGTAAATCCAGCGCAATTTTCTCAGTCCCAAGAGAGTATGAAAGATTGGAGAGTCTCTCAGCTTTCTTTACATATGTCAAATCTACTGTG
BrPRR1a    621 CCTCACCATGAGCCTACCAAGAAATATGAAATCCAGCGCAATTTTCTCAGTACCAAGAGAGTATGAAAGATTGGAGAGTCTCTCAGCTTTCTTTACATATGTCAAATCTACTGTG
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TOC1      741 CTTAGAACTAACGGTCAGGATCCTCCTCTGTCGATGGAATGGCTCACTTCATCTTCATCGGGGTTGGCGGAGAGTTTCAAGTGGTGGCTAGTGAAGGGATCAACAACACCAACAA
BrPRR1b    741 CTGGCTACCAACTGTCAAGATCCTCCCATGTCAATGGAACGGCTCACTTCATCTTCATCGGGTGTG-----GTCAATGGAATGGCTCACTTCATCTTCATCGGGGTTGGCGGAGAGTTTCAAGTGGT
BrPRR1a    741 -----GTCAATGGAATGGCTCACTTCATCGGGTGTG-----
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TOC1      861 GCACGCAGAGCAACACCAAAATCTACTGCTCTAGAACTAACGGTCAGGATCCTCCTCTTGTCAATGGAATGGCTCACATCATCTTCATCGGGGTTGGCGGAGAAAGTTTCAAGTGGT
BrPRR1b    861 -----GTTGCGGAGAGCTTCAAGTGGT
BrPRR1a    861 -----GCTGAGAGCTTCAAGCGGTG
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TOC1      981 GCTAGTGAAGGATCAACAACCAACCAAGCACAGAACTAGAGGGACCGAGCAATACCATTTCTCAAGGAGAGACCTTGCAGAAATGGCCGACGATATCCACATTCCTTGAAGCGGTCA
BrPRR1b    981 GCGAGTGAAGTCAATCAACAAGCCCAAGCAACACACAGCAAGAGACTAG-----AAAACCTTACAGAAATGGCGCG-----
BrPRR1a    981 GCAAGTGAAGTCAATCAACAAGCCCAACCAACAGCAGGAGGTAGAGAGTACAGAAAAAAGCTCAAGGAGAGAACTTACTGAACCGCACGCTTG-----AGCGGTCA
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TOC1      1001 CGCACGCTTCCACATCAATGGAATCTCATG---GTAGAACTACCAAGAGS-----GCAATATGAATATT
BrPRR1b    1001 -----CCAGGAAGAACTTCATG---GTAGAGTTACCAAGAG-----AGG
BrPRR1a    1001 CGCACGCTTCCAAACCAATGGAATCTCATGCGAGTAGGAGTTACCAAGAACTTCAAAATTCATATGAGCGGTACGACGCTTCCACCAACCAATGGAATCTACGCTACTAGGAGTTGT
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TOC1      1121 CCCCAAGTTG---CTATGAACAGAAATTAAGATTCTGCTCAAGTTGATGATCGGGTTTCTGCAACCAATGCCTATCTTACTATATGATGGGTCATGAACCAAGTTATGATGCAA
BrPRR1b    1121 AATCAGGTG---CTGTGAACAGAAATTAAGATTCTATCTCAAGTT-----GCCTATCTTACTATATGCAAGGGTCATGAACCAAGTTATGATGCAA
BrPRR1a    1121 TACCAAGAGGATCTATGATGATGCGCGGGTTGCTGCTGCTCAAGGATTCATCTCAGTTCCTGCGCAAAATGCCTATCTTACTATATGATGCTGATGAACCAAGTTATGATGCAA
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TOC1      1141 TCAGCAGCATGATGCTCAATATG---GTACATAATTCCTCATTGCCAACCAATCATCCGAATGGAATGACGGGATATCCT---TACTACCAACCCCAAT---GAACACATCTTTG
BrPRR1b    1141 TCAGCAGCATGATGCTCAGTATGCTCATCATCAATCCTCATTACCCACCTTAATCATCTCAATGGAATGACAGGAGTCTTATTAACCAACCATCCCAT---GAACACACCTTA
BrPRR1a    1141 TCAGCAGCATGATGCTCAGTATGCTCATCATCAATCCTCATTGCCCGCTTAATCATCTCAATGGAATGACAGGAGTTCTTATTAACCAACCAACCATGATGACATCTGTTA
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TOC1      1261 CAGCATAGTCAGATGCTTTACAGAATGGTCAGATG---TCTATGGTTCATCTTCTGGTCACCGGCAGGA-----AATCCGCTTCTAATGAGGTGAGGTAAATAAATTTGAC
BrPRR1b    1261 CAGCACAATCAATG---TCAAGAAATGGTCAGATG---TCTATGGTTCATTAT-----CATCCGTCATCTAACGAGGTGAGAGCGGATGAACCTTTGAC
BrPRR1a    1261 CAGAAGCGTCATGTCCTTACAGAATGGTCAGATGCTCCTATGTTTCATCATCATCTTCTGGCCACAGGTGGGAACCAACCGCTCTCCTAACGAGGTGAGGTGACTAAGCTTTGAC
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TOC1      1381 AGAAGAGAGGAAGCTCTGCTGAAATTCAGACGTAAGGAACCAACAGTGTGTTTGTATAAGAAGATTAGGTATGTGAATAGGAAGCGCTTCTGCTGAGAGGAGACCCCGGTTAAGGGTCAG
BrPRR1b    1381 AGAAGAGAGGAAGCTTTGCTTAAATTTAGACGTAAGAGGAACCAAGGTGTTTGTATAAGAAGATTAGGTATGTGAATAGGAAGAGCTCGCTGAGAGGAGCCGCTGTTAAGGGTCAG
BrPRR1a    1381 AGAAGAGAGGAAGCGTTGCTTAAATTTAGACGTAAGAGGAACCAAGGTGTTTGTATAAGAAGATTAGGTATGTGAATAGGAAGAGCTTCTGCTGAGAGGAGCCAGCTGTTAAGGGTCAG
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TOC1      1501 TTTGTTAGGAAGATGAACGGCGTGAATGTTGATTAAATGGACAGCTGACTCT-----GCTGACTATGATGACGAGGAAGAGGAGGAAGAAGAAGAGAGGAGAACCCGGGATTCA
BrPRR1b    1501 TTTGTTAGGAAGATGAACGGGTGAATGTTGACTTAAATGGGAGCCT-----GACTATGATGACGAGGAAGAGGAGGAGGATGAAGAGGAAGAGGAGGAATAGGGACTCA
BrPRR1a    1501 TTTGTTAGGAAGATGAACGGCGTAAATGTTGACTTGAACGGGAGCCTGAACCTGACTCTGCTGACTATGATGACGAGGAAGAGGAG---GATGAAGAAGAGAGGAGATCGGACTCG
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TOC1      1621 TCTCCTCAGGATGATGCTTTGGGAACCTGA
BrPRR1b    1621 TCTCCTCAGGATGATGCTCAGGGAACCTGA
BrPRR1a    1621 TCTCCTCAGGATGATGCTTTGGGACTGA
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(B)

	Pseudo-Receiver	E	
APRR1	MDLNGECKGG--DGFIDRSRVRLLCDNDSTSLGEVFTLLSECSYQVTAVKSARQVIDALNAEGPDIDILAEIDLPMK		78
BrPRR1a	MDLNGECKGGGDGFIDRSRVRLLCDNDENSLGEVFTLLSQCSYQVTSVKSARQVIDALNAEGPDIDILAEIDLPMK		80
BrPRR1b	MDLNGECKGG--DGFIDRSRVRLLCDNDSSKSLGDVFTLLSQCSYQVTSVKSARQVIDALNAEGPDIDILAEIDLPMK		78
APRR1	GMKMLRYITRDKDLRRIPVIMMSRQDEVVVVKCLKLGAAADYLVKPLRTNELLNLWTHMWRRRRMLGLAEKNMLSYDFDI		158
BrPRR1a	GMKMLRYITRDKDLRRIPVIMMSRQDEVVVVKCLKLGAAADYLVKPLRTNELLNLWTHMWRRRRMLGLAEKNMLSYDFDI		160
BrPRR1b	GMKMLRYITRDKDLRRIPVIMMSRQDEVVVVKCLKLGAAADYLVKPLRTNELLNLWTHMWRRRRMLGLAEKNMLSYDFDI		158
APRR1	VGSDSDPNTNSTNLFSDDDTDRSLRSTNPORGNLSHQENESVATAPVHARDGGLGADGTATSSSLAVTATEPPLDHLAC		238
BrPRR1a	VGSDSDPNTNSTNLFSDDDTDRSIRSTNPORC--SHQEKWVPVPTGSCVCGDC--AADGTATSTPPVATIEPPLNHLPE		236
BrPRR1b	VGSDSDPNTNSTNLFSDDDTDRSIRSTNPLRCPLSRQEKECPAATGGSV-----DGTATSA-----PPLNHLPG		223
APRR1	SHHEPMKRNSNPQOFSSAPKKSRLKIGESSAFFTYVKSTVLRITNGQDPPLVDGNGSLHLHRL--AEKFOVVASEGINNTK		317
BrPRR1a	PHHEPTKRNTNPQOFSSVPKKSRLKIGESSAFFTYVKSTV-----NGNGSVH--PGM--AEKLOAVASEVINNAK		302
BrPRR1b	SHHEP-----NPEKFSSVPKKSRLKIGESSAFFTYVKSTALATNQCDDPHVNGNGSLHLHPGVVAEKLQVVASEVINKPK		298
APRR1	QAR--RATPKSTVLRITNGQDPPLVNGNGSHH--HGAAEKFOVVASEGINNTKQAHRSRCTEQYHSQGETLQNGASYPHSI		395
BrPRR1a	QTEGGRETEKN--KAQGEN--LVNGT--LER--SRTLEPTMELHGSRSYQEV--PNSI		350
BrPRR1b	QTHRSRETEKNLQNGGATE-----		317
APRR1	ERSRTLEPTSMESHG--RN--YQEGNMNIPQVAMNRSKDSSQVDGSGESAPNAYPYMHGVMNQVMQSAAMMPQYGH--QIPH		472
BrPRR1a	ERSRTLEPTPELHGTRSCYQEGSMDDARVAA--AKDSSQ--EPQONAYPYMHGVMNQVMQSAAMMPQYGHQHHPH		423
BrPRR1b	-----ELHG--RS--YQERN--QVAVNRSKDSSQV-----AYPYMHGVMNQVMQSAAMMPQYGHQHHPH		372
	CONSTANS-Motif		
APRR1	CQPNHPLNGMTGVPYYHH--PMNTSLQHSQMSLQNGQMS--MVHH--SWSPAGNDPS--NEVRVNKLDREAEALLKFRKRKNQ		546
BrPRR1a	CPPNHPLNGMTGVPYYHH--PMNTSLQGHVPLQNGQMPMVHHHSWPQVGNHPSNEVRVTKLDREAEALLKFRKRKNQ		503
BrPRR1b	YPPNHPLNGMTGVPYYHH--PMNTPLQHNQMS--QNGQMS--MVHY-----HPSSEVRASKLDREAEALLKFRKRKNQ		440
APRR1	RCFDKKIRYVNRKRLAERRPRVKGQFVRKMGVNVDLNGQPE--DSADYDDEEEEEEEEEENRDSSPQDDALGT-----		618
BrPRR1a	RCFDKKIRYVNRKRLAERRPRVKGQFVRKMGVNVDLNGQPEPDSADYDDEEEEEEEEEENRDSSPQDDALGT-----		576
BrPRR1b	RCFDKKIRYVNRKRLAERRPR-----PDYDDEEEEEEEEEENRDSSPQDDAAGT-----		490

Figure S1. Comparison of *Arabidopsis* *PRR1* and its *B. rapa* orthologs *BrPRR1a* and *BrPRR1b*. Alignment of mRNA (A) and amino acid sequences [28] (B).

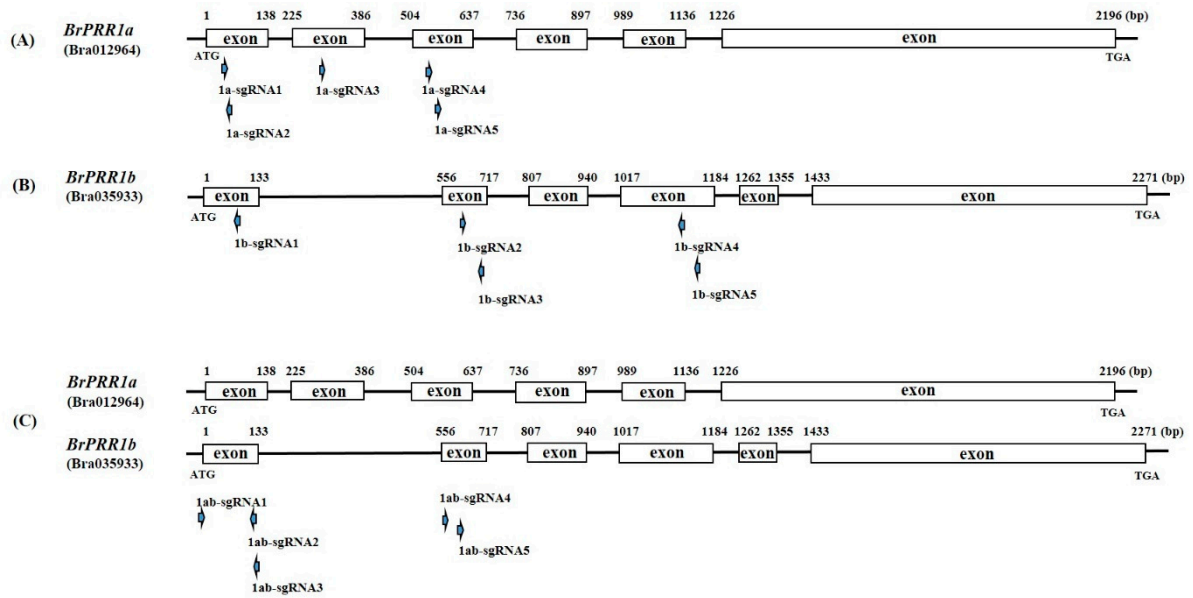


Figure S2. Schematic maps of the sgRNA target sites of *BrPRR1a* and *BrPRR1b* in *B.rapa* genome. Arrows show the positions of sgRNA target site for *BrPRR1a* (A), *BrPRR1b* (B), and *BrPRR1a* and *BrPRR1b* double mutations (C).

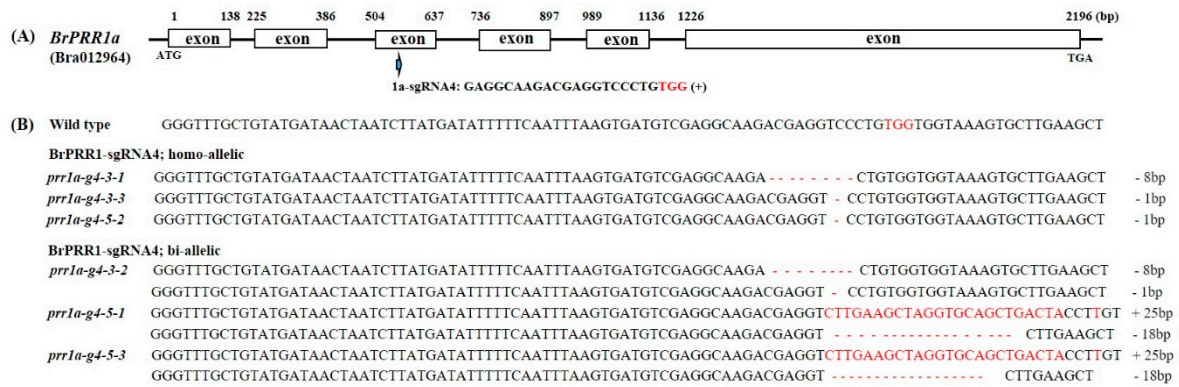


Figure S3. Genome editing of the Chinese cabbage *BrPRR1a* gene. Design of sgRNA site for *BrPRR1a* exons. The PAM motif (NGG) is shown in red (A). Next-generation sequencing (NGS) alignment of the sgRNA target region in different mutant lines. Deletions and insertions are indicated by dashes and red letters, respectively (B).

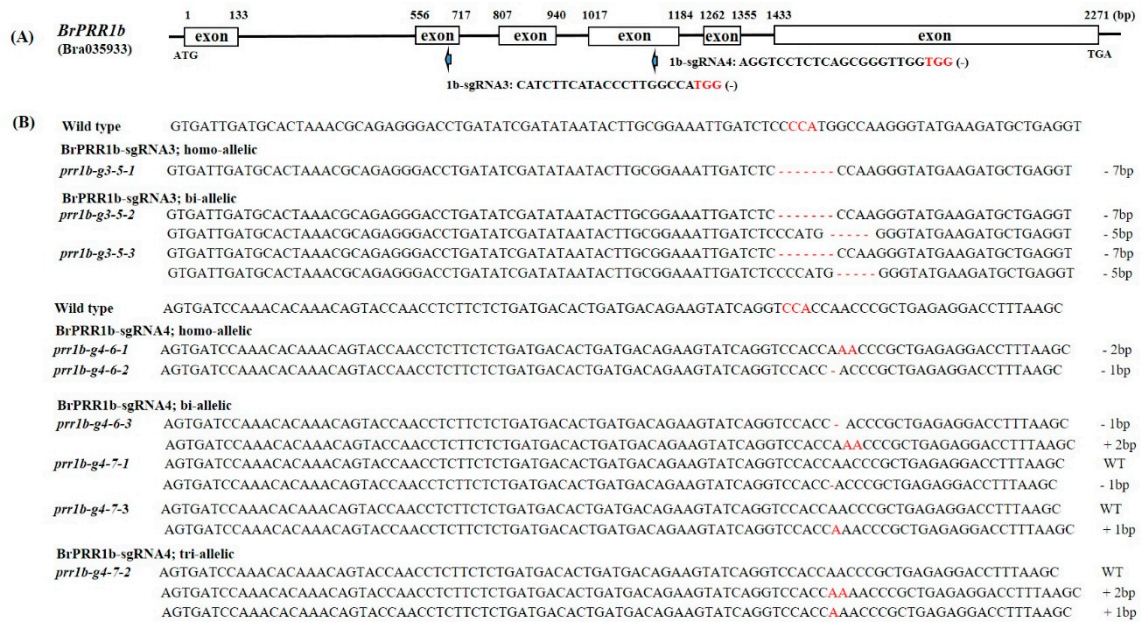


Figure S4. Genome editing of the Chinese cabbage *BrPRR1b* gene. Design of sgRNA sites for *BrPRR1b* exons. The PAM motif (NGG) is shown in red (A). Next-generation sequencing (NGS) alignment of the sgRNA target region in different mutant lines. Deletions and insertions are indicated by dashes and red letters, respectively (B).

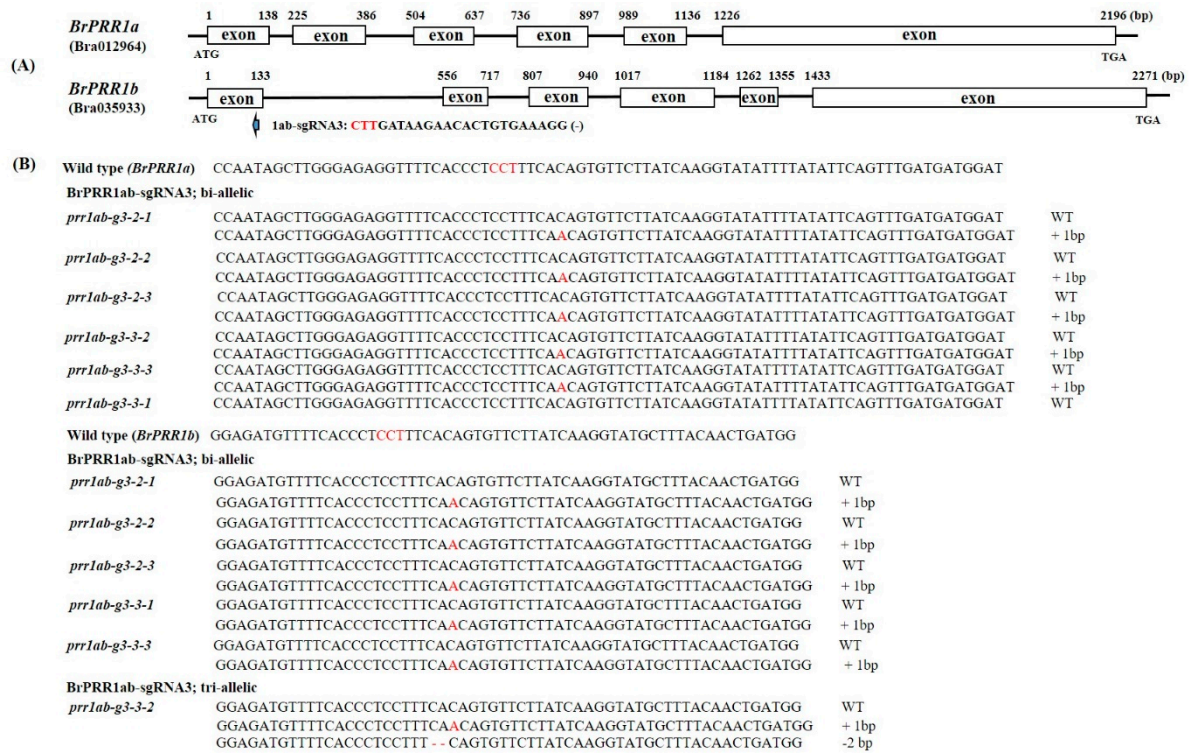


Figure S5. Genome editing of the Chinese cabbage *BrPRR1a* and *1b* genes. Design of sgRNA site for *BrPRR1a* and *1b* exons. The PAM motif (NGG) is shown in red (A). NGS alignment of the sgRNA target region in different mutant lines. Deletions and insertions are indicated by dashes and red letters, respectively (B).

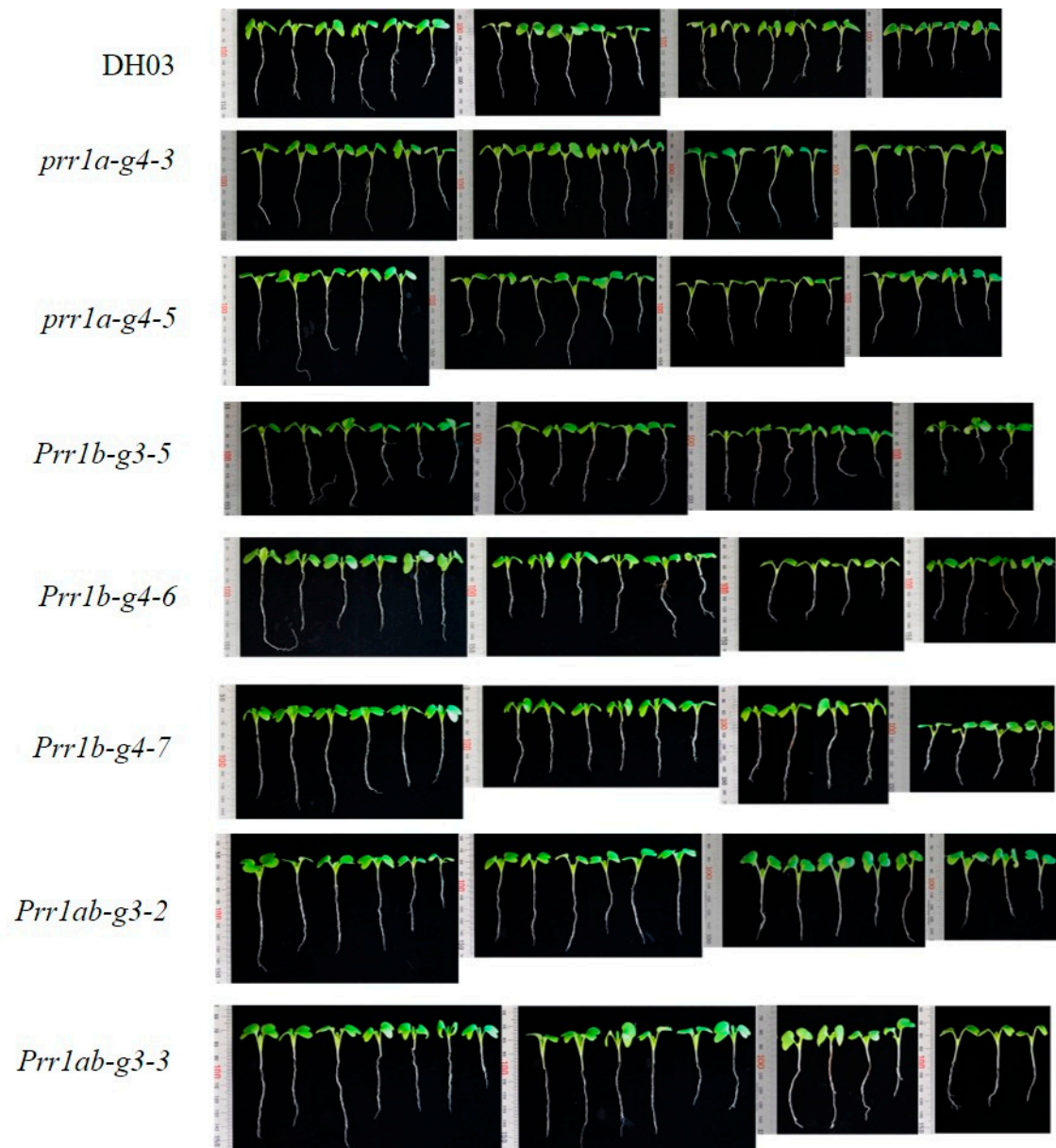


Figure S6. Phenotypes of 20 seedlings of BrPRR1a, BrPRR1b, and BrPRR1ab T₁ mutants in Chinese cabbage.

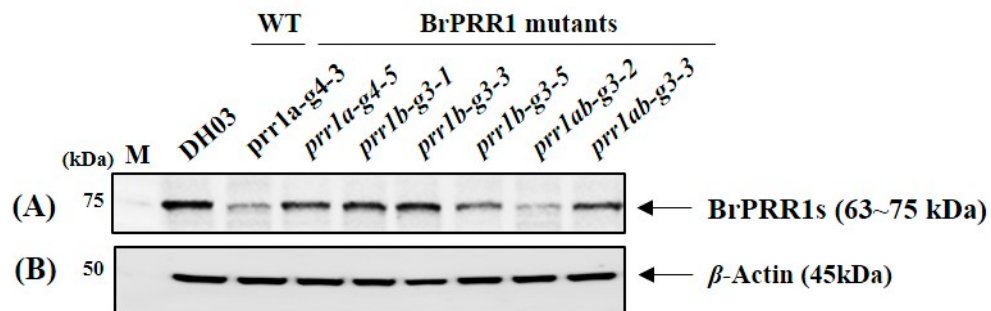


Figure S7. Protein expression of BrPRR1s in BrPRR1 mutants determined by Western blotting analysis. To determine the protein expression in BrPRR1a, BrPRR1b, and BrPRR1ab mutants, samples were collected at ZT12 with liquid nitrogen and at -80°C prior to use. $80\mu\text{g}$ of total protein extract was separated by 8% SDS-PAGE and electroblotted onto PVDF membranes. Primary and secondary antibody were used rabbit anti-TOC1 polyclonal antibody (Abiocode, Agoura hills, CA, USA) and goat anti-rabbit HRP conjugated antibody (A). β -actin was used for loading controls (B).