Appendix A PCR primers used in this study

Purpose	Accession number	Forward primer (5′)	Reverse primer (5′)
TaARR1 expression	AK333193	CGGGTGACTGCCTGGGACTT	TACCGAGTTGCAAAGTAAGCAATG
Tatubulin expression	U76558	CATGCTATCCCTCGTCTCGACCT	CGCACTTCATGATGGAGTTGTAT
Nttubulin expression	U91563	TACACAGGGGAAGGAATGG	CTCGAAACCAACGGTATC
TaARR1 overexpression cassette	AK333193	AAAAGATCTGATGGTGGGCGCCGGCGA	AAAGGTGACCTTTCAGCTACTACTCTGG
NtNRT1.1-s expression	AB102805	TACCGGTTTGTCGACGTGTC	TCTCTTCTCCTTGTACACATAC
NtNRT1.1-t expression	AB102806	CCGGCTTCATTGACACTCTT	CCTCTTCTCCTTGTACACATAC
NtNRT1.2-s expression	AB102807	GGGTTATCGTTCCCATTTGTCGT	TCAGCAAGTCTCTTCTCCTTGT
NtNRT1.2-t expression	AB102808	GCCCTAACAGAGGTTAAGAGG	TCCCCATTTCAGCAAGTCTC
NtNRT2.1 expression	AJ557583	TAGCCGTCACATTCATGATCCTT	GATCGGCAGTTCTCGGCGAA
NtNRT2.2 expression	AJ557584	CGTCGATCGTTAGGTATAATC	ATTAACTACTCACACTTGGGTAA
NtNRT2.2 knockdown expression cassette	AJ557584	TTTCCATGGAGTAACCATAGAGCA	TTTGGTAACCTCACGGTCTAACTT
NtNR1 expression	X06134	ATCAGGTGGATGGATGGCGA	ACAACCAACTCGAAGTACCC
NtNR2 expression	X14059	AGATGAATGTGTGCAAGCCTC	GTCATAGCCCATCTTCTCCAA
NtNR3 expression	JN384020	AACACCCGACTCAACCTGGA	TGGTCCACAAGCCAAAGCC
NtNR4 expression	JN384019	TGTTTGAGCATCCGACTCAAC	GGAGGTGGTCCACAAGCCA
NtNR5 expression	XM_016606384	ATGGATATTACCGGCCGGCA	TTACGTACCATCAGCATTAACA
NtNR6 expression	XM_016583028	TTGAGGCACTGCTCAAAGAGC	TCCCAAATGTGAATCACTCCC
NtNIR1 expression	NM_001324935	ATGGCATCTTTTTCTGTTAAAT	TTAATCTTCTGCTTCTTCTCTT
NtNIR2 expression	X66145	AATCCGTGCGTAGTAGGCTC	CCAAATCATCACAAGGAACAGC
NtNIR3 expression	X66147	TGGCAATTCACGAGGCAATC	TCGTGGAACTGCACCAAAGT
NtNIR4 expression	XR_001649867	TGGTTTCAGAGGGAACAGAC	GCAAGTCCACAACAAGTGGTA
NtNIR5 expression	XM_016583028	AGCATCTCCAGAAGACTTGG	CCCAAATGTGAATCACTCCC
NtGS1 expression	NM_001325250	ATTATGTCTCCGCTTTCAGATC	ATTGAGCAAACCAGAAACAAGC
NtGS2 expression	X95932	AATATGGCTCATCTTTCAGATC	CCTCAAAAGACGACTACACAC
NtGS3 expression	XM_016631331	CATTATGTCTCTGCTTTCAGAT	TCATGGCAGTAACGACGTATGG
NtGS4 expression	XM_016579636	TATATGTTAATTATGTACAGTT	CATCCTGATCTCTCTGATGC
NtGS5 expression	XM_016640903	CGGGCATGATCAGAATTATTC	AGATTGGTCGGGATATGAACC
NtGS6 expression	XM_016640901	AAAATGAACAGATCAGACTCCA	GGTCGGGATATGAACCTAAAA

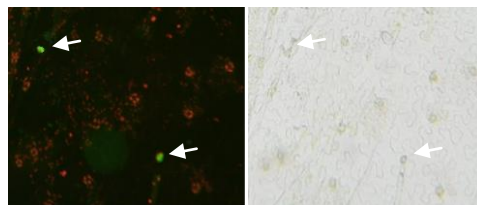| NtGS7 expression	XM_016584731	AAGATGGCTCAGATCTTGGCTC	CTTTAAACATTCAATGCGAGCT
NtGS3 knockdown expression cassette	XM_016631331	AAACCATGGTGTGAGCACCTGCACCG	AAAGGTAACCTGATGTTGTTGCC

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1     GAGTTTAGCATACCACCAGATAATGGAGCGGGGCGGACTGCGACGGGCGGAGGCACCCGCCGCCGGGCGCGGCCGG
76    CCGTTCCTAGTACAGGTCACTGCCGACAGGCCGCAATCCGTCGTCCTCCGGCCGCGGGGAACTCGCCGGCGAGCCGA
151   GTTGATTGGGGGGGTGCCAGCGGCCGCATGCATGGAGGAGGAGGCGTCCGCAGATCCAACAGCCGCCTCGTCCTCC
226   TGCGTCTAACCTCTCTGGCTGCGGGCTCTGCTGATTCGTCCTAACGCGCGCACGGGTGACTGCCTGGGACTTGGG
301   TATGGTGGGCGCCGGCGAGGGGGTTCGCGCTGGCGGCAGCGGCGCCGGGGTAGGGGCAGGGGCAGGGGCAGGGCA
         M  V  G  A  G  E  G  V  R  A  G  G  S  G  A  G  V  G  A  G  A  G  Q
326   GCCGTTCGTTGACCGGAGCAAGGTGAGGATCCTCCTCTGCGACAGCGACCCAGACAGCTCACAGGATGTGCTTCG
         P  F  V  D  R  S  K  V  R  I  L  L  C  D  S  D  P  D  S  S  Q  D  V  L  R
451   CCTCCTCTGCAACTGCTCCTACCAGGTGACCTGCGCCAAGTCTCCACGGCAGGTGATCAACGTGCTCAACTGCGA
         L  L  C  N  C  S  Y  Q  V  T  C  A  K  S  P  R  Q  V  I  N  V  L  N  C  E
526   GGGCGCTGAGATAGACATCATCCTGGCCGAGGTCGATCTGCCAGTTTCGAAGTGCTTCAAGATGCTCAAGTACAT
         G  A  E  I  D  I  I  L  A  E  V  D  L  P  V  S  K  C  F  K  M  L  K  Y  I
601   TGGCAGGAACAAGGAGCTGCGCCATATCCCCATCATCATGATGTCCAACAGAGACGAGGTTTCTGTCGTTGTCAA
         G  R  N  K  E  L  R  H  I  P  I  I  M  M  S  N  R  D  E  V  S  V  V  V  K
676   GTGCTTGCGGCTCGGGGCAGCAGAGTACCTGGTCAAGCCGCTTCGCATGAATGAGCTGTTGAATCTCTGGACCCA
         C  L  R  L  G  A  A  E  Y  L  V  K  P  L  R  M  N  E  L  L  N  L  W  T  H
751   TGTGTGGCGAAGGAGACGGATGCTTGGTTTGGCCGAGAAAAACTTCTTCATTGACAATCTTGAGTTAGTGCTGTC
         V  W  R  R  R  R  M  L  G  L  A  E  K  N  F  F  I  D  N  L  E  L  V  L  S
826   GGAACCTAGTGATGCCAATACCAATAGCACCACACTCCTTTCGGACGAGACAGATGATAAGCCAAAAGGAAATAG
         E  P  S  D  A  N  T  N  S  T  T  L  L  S  D  E  T  D  D  K  P  K  G  N  R
901   AAATCATGAACAAATACCTCGAGTCAACATGAATATGAGTCTCCTGCTGTGGACCCTCCAAAAACAGACCAATT
         N  H  E  T  N  T  S  S  Q  H  E  Y  E  S  P  A  V  D  P  P  K  T  D  Q  L
976   GGAAAATTTACCTAGCATTGCGGAAGATGATGATAAAGCATCATCTCCAGGAGGAATGTTTTCACGCCCAATAAA
         E  N  L  P  S  I  A  E  D  D  D  K  A  S  S  P  G  G  M  F  S  R  P  I  K
1051  GACTAATTTGAGGATAGCTGAGTCGTCTGCATTTCTTAGCATATGTTAAATCAAGCACTCCAGCAAACAACCCATT
         T  N  L  R  I  A  E  S  S  A  F  L  A  Y  V  K  S  S  T  P  A  N  N  P  L
1126  GGATAATGAACTACAGAGAGAGGGTAATCAGATAGACGTTATGGATCACCAGGGTAATTTCTCTGGTGCGACCGA
         D  N  E  L  Q  R  E  G  N  Q  I  D  V  M  D  H  Q  G  N  F  S  G  A  T  D
1201  CAGAATCGACACTAATGGTAAAATAAATATTCAGGATGAAAAAGCTTTTGAGACGCCTATGCAGTATCCTTTGGT
         R  I  D  T  N  G  K  I  N  I  Q  D  E  K  A  F  E  T  P  M  Q  Y  P  L  V
1276  ATGCTTTTCTTCCTCTAACTTGCATCTGGAGCAAAGGAATGAGGGCCAGCAAGATGTTTCAGGAAACCCTCCTGT
         C  F  S  S  N  L  H  L  E  Q  R  N  E  G  Q  Q  D  V  S  G  N  P  P  V
1351  GTATCATACCCATTTTATTATCCAGGGATGGTAGAGCATGGCATGACACTTCATTCAGTTCAAAGTTTCCAAGG
         Y  H  Y  P  F  Y  Y  P  G  M  V  E  H  G  M  T  L  H  S  V  Q  S  F  Q  G
1426  AAACATAAACACTGCTCAAGCTCATACACCACCAACAATGCTCCATCAATACAATGTTTATCACCAATCCCATGG
         N  I  N  T  A  Q  A  H  T  P  P  T  M  L  H  Q  Y  N  V  Y  H  Q  S  H  G
1501  TGCATCGATGCAATCGTATCAGTATAGTCCTGCTGGTATGAATGTGCATTCAAGTCATTTGTCAACACAGAATGT
         A  S  M  Q  S  Y  Q  Y  S  P  A  G  M  N  V  H  S  S  H  L  S  T  Q  N  V
1576  GTGGTCGTCGGTATCGAGCACCAATTCTCGAGGAAAGACATAGTCGATCTGGCAGGAGAGCTGCAGCACTTGC
         W  S  S  V  S  S  T  P  I  L  E  E  R  H  S  R  S  G  R  R  A  A  A  L  A
1651  AAAATTCAGGCAGAAAAGGAAGGACCGCTGTTTTGACAAGAAGGTGAGGTATGTTAATCGGAAGAAAGTTGCTGA
         K  F  R  Q  K  R  K  D  R  C  F  D  K  K  V  R  Y  V  N  R  K  K  V  A  E
1726  AACAAGGCCGAGGGTGCGGGGTCAGTTTGTTAGGCAGGCAAGCAACACAGATATAATTAGCACTGGTGATGATAT
         T  R  P  R  V  R  G  Q  F  V  R  Q  A  S  N  T  D  I  I  S  T  G  D  D  I
1801  TTCTGAATACGAAGACGATGATCCATCCTCCAGGGACGTTGAGTTGGTTTCTTCACCAGATTAGCTGAAAGGTCG
         S  E  Y  E  D  D  D  P  S  S  R  D  V  E  L  V  S  P  E  *
1876  TATTATATGTGGGAGTGAGGATGATCATTGCTTACTTTGCAACTCGGTACACAAATGCAATGCATTATTCCTGCT
1951  AATAGCAATGCATCATTTTGCTTTCACAATACATCCTCAACCCCCAACCCCTCAAAAGAACTTCTGGCATATGTA
2026  TGGATATTATTGTGGACATTTTGAGCAATTGTATTTTGACAATGTAAGTTAGTATCACTAGTCAGTGATACACAT
2101  GGCATTGTGACAAACTCTATGACCTCTTTGTCTCTGCGCTTGTCTAGTTTCATTGTCTCTGTTATTTAATACACA
2176  TAGTATTTGTTTTCACCAAAAAAAAAAAAAAAAAACGA
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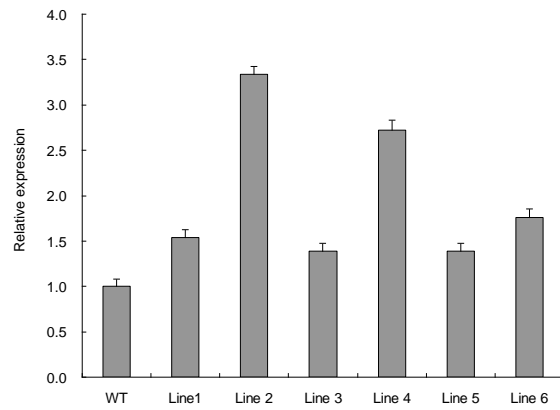
Appendix B   The full-length cDNA of *TaARR1* and its translated polypeptide.   ATG, translation start codon.   TAG, translation termination codon. The conserved receiver domain in TaARR1 protein (34 aa-302 aa) is highlighted by yellow color whereas the output domain (446 aa-487 aa) is shown in pink color.
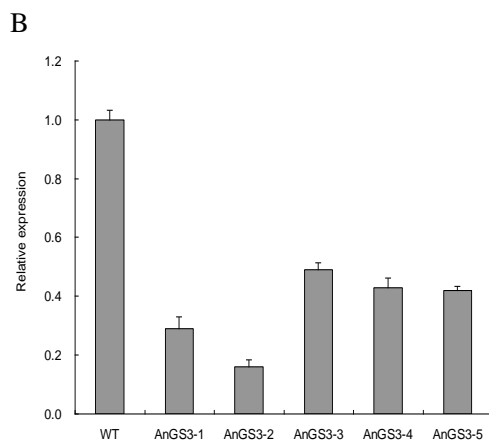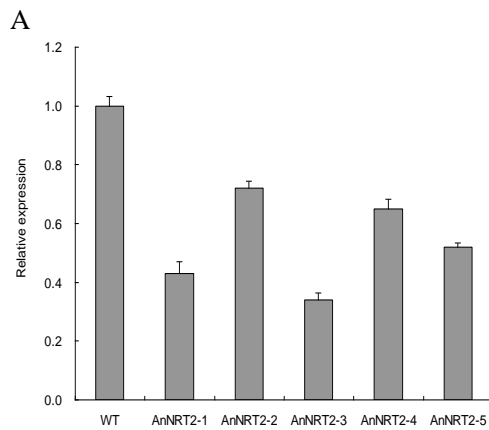

Under green light   Under white light

Appendix C   Localization characterization of the TaARR1 protein.   The GFP signal derived from the TaARR1–GFP fusion in tobacco epidermal cells. The arrows direct to nucleus.

Appendix D The expression levels of target gene in transgenic lines with *TaARR1* overexpression. WT, wild type. Lines 1 to Line 6, transgenic lines with overexpression of *NtNRT2.2*. Error bars indicate the SE values.

A

B

Appendix E The expression levels of target genes in transgenic lines with knockdown of *NtNRT2.2* and *NtGS3*. **A**, expression levels of *NtNRT2.2*; **B**, expression levels of *NtGS3*. WT, wild type. AnNRT2-1 to AnNRT2-5, transgenic lines with knockdown of *NtNRT2.2*. AnGS3-1 to AnGS3-5, transgenic lines with knockdown of *NtGS3*. In **A** and **B**, error bars indicate the SE values.