

Figure S1. The observed frequencies of TFPN (**A**) and PNPP (**B**) in RHL family #5.

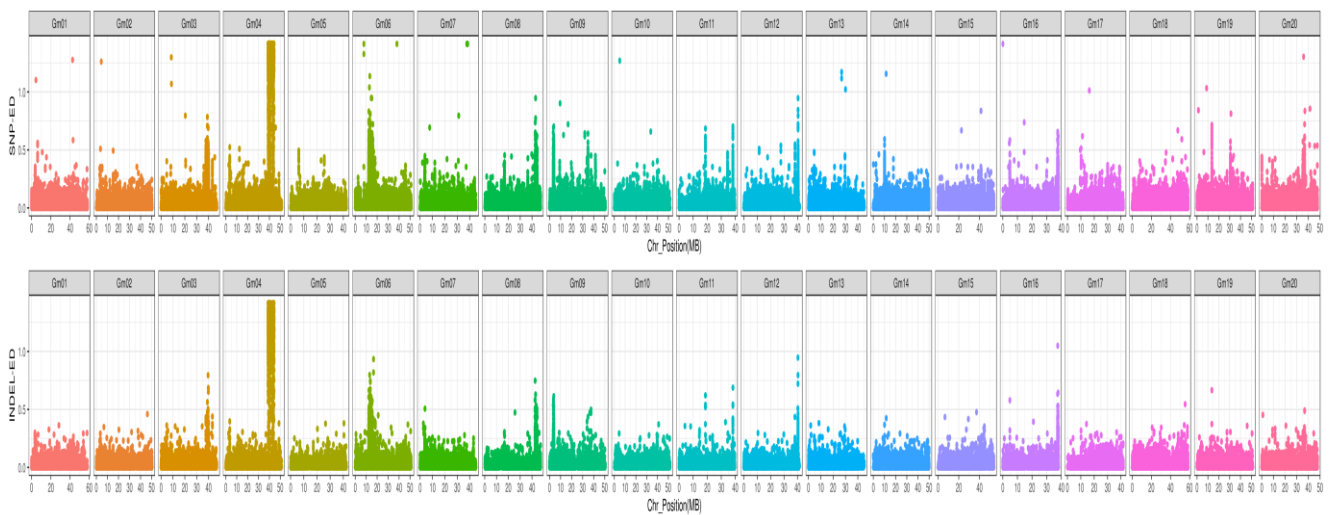


Figure S2. The distribution of Euclidean distance (ED)-associated values on 20 chromosomes.

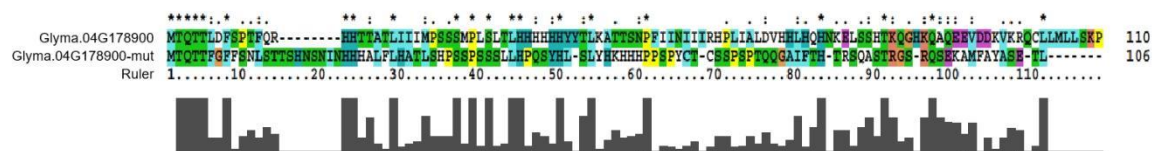


Figure S3. The protein sequence alignment of Glyma.04G178900 and its mutant (Glyma.04G178900-mut).

Table S1. Indel markers used for mapping QTL for TFPN and PNPP.

Markers	Chromosome	Forward primer (5'-3')	Reverse primer (5'-3')
PSI0151	GM2	CGGGAATAACAGCAGAGATA	CGAGTCCCTACTCAGTTCAC
PSI0160	GM2	CATTGTTACTACTTTACACCTTTTG	TGACGAAAGCATCAATTAAA
PSI0204	GM2	TGTTTACTTTTGTTAGACACCG	AAAACCTCTTTTAGGGTGTGTTTT
PSI0213	GM2	GGAGCTTATTAGCTTCTTTGAT	CAAAATTTCAAATAAAATCATGC
PSI0295	GM2	TGCATTCAACACGAAATCTA	TGCCTTTTTCTTCTCTTCTTC
PSI0492	GM4	TCGTTTCTTTAGTAGGGTAGGA	TGCACAAATAGTTAGATGAAACA
PSI0526	GM4	TTTTGGAGTTAGGTTTGGTG	CCATCGCATTTCAAAAGTTA
PSI1469	GM10	TTCTCCGGTTGATGATAA	ATTAACGCTTAATTCAACTTC
PSI1531	GM10	TCTGTCAACGCAGTACTTCTC	TCAGTGTTCACAACTGATGATT
PSI1654	GM11	CCAAATTATTTTAGAGAAGATCG	CAAATTCAGCCTGTGTCTTT
PSI1797	GM12	GATTTCGTACCTCTTTATATTTTT	CCTAATGCTTATGCCAAA
PSI2296	GM15	GCAGTAAATGTGGACAAAAGA	AAACACAGTGATGTTAGAAAAA
PSI2368	GM16	CGTATCAGTCTGGATCATGG	GAACAGTGTTGCTGTTGTTG
PSI2525	GM16	AGTAGTCATTTATAAGAATTTTCAA	TTATCAACAATATTTTTAAAAGGG
PSI3010	GM20	CGACTAACTCTTAATGTATTTTGC	CAACTTCACTCTCAGATCGC

Table S2. Indel markers used for fine mapping *qFPN4* locus and detecting NILs.

Markers	Genomic position	Forward primer (5'-3')	Reverse primer (5'-3')
ID4033	2513639	GGGGCAATATCCCCAAAC	CGATGCCCATTGTCTGAAT
ID4082	3802178	TCTTATGGCGCAAGGCTC	TGTTATGAAACCAAAGGTTTCG
ID4215	13760852	ATGATGGTGGCCAGGAGA	TGTTGCTTCTCATTAGGCCC
ID4228	15655819	TGGGATGCCTTAGTCCCA	AGGAGGGAATTTCTCCTTCAG
ID4237	16671461	ACATTCCCGATGGAGGGT	TGAGAAGAGTGAAGGATGGTG
ID4254	20177422	TTCTCCGACTGAACACCACA	CCGTTGATCCAGAATCGG
ID41032	24910066	TTTGCCACATTTGGTGCTCCAACG	AGAGGAAGAAAGAGGAAGC
ID41040	30260000	TACACAGTTAATAAGGGAAGC	GTTAATGAAATGTTTCTCGACTGG
C1-1	35948983	TTCAAGCATCACACCCAAGA	GGACTTCAACTCAACTCCCAA
C1-2	41395555	TTTTTGTGTGTTGCATTTGCAGC	ATCTTTTAGAGAAGGTAATATGAG
C1-3	41559265	GTATGTTGTGTGGGGTTCGATTCC	TCTAGTATACAATTCTGAATGACC
C1-4	41754458	AAAAGCTAGCTATTGTAGTTG	TAAAACCAATTTTCAGTAGCATGG
C1-5	44330411	ATCTCCTTGCAACCGCAC	TTGAGTATAATGGCCTTCCCA
C1-6	44375173	GCAAGTCAAAGTGGTTTGATG	GCCCACTCTAATCGGCAT
C1-7	44383419	GGCGCATACATCGTCCTT	AGGGTCATGGGGAGGTGT
C1-8	44458681	TTCAATTTTCATATTTTCATCTGC	CCCTTCTAGAATCCTTCACAACC
C1-9	44697227	AAGAGTTTTTCAATAATGATACC	TAGTGTTTTAACTGAGATATTAC
C1-10	45438062	ATTTTCAGGGGGCTTTTCG	TTCAGCGGCTTTCAGTCA
ID4421	49830273	ACTGCACATTGCCTGCTG	ATGCTTGGACGCTTCTCG

Table S3. Mapping QTL for TFPN and PNPP in the F₆ JT RIL population.

Traits	Indels Marker	Genomic position	LOD	¹PVE (%)	Additive effect
TFPN	C1-7	44383419	4.64	13.1	16.2
PNPP	C1-5	44330411	5.05	14.2	17

¹ phenotypic variation explanation ratio.