

a

Os1i13	MAMATSTFSPPASQLSLTRRLHPGPDLLTLSSPRLRAGLRARAAAGEAPVETVEAPPSKPEAEPSPAASNGAAVKAEPAAAAAPPLPKFRDSRWVN	100
OsLIL3	MAMATSTFSPPASQLSLTRRLHPGPDLLTLSSPRLRAGLRARAAAGEAPVETVEAPPSKPEAEPSPAASNGAAVKAEPAAAAAPPLPKFRDSRWVN	100
Os1i13	GTWDLRQFEKGGAVDWDAVIDA DEAGQEREMA EKLNGRAAMIGFFMAYFVDSLTVGLVDMQGNFFCK	133
OsLIL3	GTWDLRQFEKGGAVDWDAVIDA EARRRKWLEDC PEATSPDEAVVFDTSIIPWWAMKRFHLPE EKLNGRAAMIGFFMAYFVDSLTVGLVDMQGNFFCK	200
Os1i13	TLLFVAVAGVLLVRKNEDIETVKKLIDETTFYDKQWQATWQDESQPK	133
OsLIL3	TLLFVAVAGVLLVRKNEDIETVKKLIDETTFYDKQWQATWQDESQPK	249

b

OsLIL3	MAMATSTFSPPASQLSLTRRLHPGPDLLTLSSPRLR.....AGLRARAAAGEAPVETVEAPPSKPEAEPSPAASN	72
<i>Hordeum vulgare</i>	MAMATSTFSPPASQLSLTRRLHPGPDLLTLSSPRLR.....AGLRARAAAGEAPVETVEAPPSKPEAEPSPAASN	66
<i>Zea mays</i>	..MATSTFSPPASQLSLTRRLHPGPDLLTLSSPRLR.....VACATA...AGEAP...PVEQRDEVEPASAAASN	64
<i>Cucumis sativus</i>	..MSSMALFSPPSHLSTFSPSHHTTHFSFRPFSSLRTRNPSSSSSLFTIRATADNGAGISGGSATVSVETPVEQKDPEPAKLAP	83
<i>Nicotiana tabacum</i>	MMSSMALFSAPPPHPTLSP..PKPHLTHKLYIPLTLKKP.....HFSFRAVDD...VITATSAVTIE...QEKAESNGVAL	70
AtLIL3:2	MSISMALFSPPISSSLQNPNIPIKISTLLSTKRFSLS.....VPRASSDNGTTSP...VVKIPKASVAVEEVPVKSP	72
AtLIL3:1	MALFSPPISSSLQNPNIPIKISTLLSTKRFSLS.....VTRASSDSGSTSPTAAVSVEAPEPVEVIVKEPPQSTP	73
<i>Chlamydomonas reinhardtii</i>	MQMLASSSRSAIRASRPTGSSRSSVVVRATAEAPVVE.....KKERKLG.....PLERGTTLSGDAAGKDA	62
OsLIL3	G....AAVKAEPAAAA...APPLPKFRDSRWVNGTWDLRQFE..KGGAVDWDAVIDAEARRRKWLEDCPEATSPDEAVVFD	146
<i>Hordeum vulgare</i>	GSAAPAAPVAAAAAPVAAAAA.EAVASPKFQDSRWVNGTWDLRQFE..TGGAVDWDAVIDAEARRRKWLEDCPEATSPDEAVVFD	149
<i>Zea mays</i>	G....TAVKVEASAAKPESPPAPAPVPAFRDARVWNGTWDLRQFE..KGGAVDWDAVIDAEARRRKWLEDCPEATSTDDAVVFD	142
<i>Cucumis sativus</i>	EEQ..ESLAGTNGSVAAAEV..EVVSKFEDPKVWNGTWDLRQFE..KNGSTDWDAVIDAEARRRKWLEDCPEATSTDDAVVFD	162
<i>Nicotiana tabacum</i>	NSN..GSPPAVSAGAPAAEEG...VRKFQDSRWVNGTWDLRQFE..KDGKIHWDVDAIDAEVRRRKWLEDCPEATSTDDAVVFD	146
AtLIL3:2	AE...SSASENGAVGGEATDSSTETVIKYONAKVWNGTWDLRQFE..KDGKTDWDSVIVSEAKRRKWLEDCPEATSTDDAVVFD	152
AtLIL3:1	AVKKEETATAKNVAVEGEEMKT.TESVIKFQDARVWNGTWDLRQFE..KDGKTDWDSVIVSEAKRRKWLEDCPEATSTDDAVVFD	155
<i>Chlamydomonas reinhardtii</i>	G...DKARAMATGVTAKPVTILQIVDGRFRDRWIDGRWDLSEKSAKTGEVDWDLVDAIDAEVARRKLEDCPEATSTDDAVVFD	143
OsLIL3	TSIIPWWAWMKRFHLPEAEKLNRAAMIGFFMAYFVDSLTVGLVDMQGNFFCKTLLFVAVAGVLLVRKNEDIETVKKLIDETTF	231
<i>Hordeum vulgare</i>	TSIIPWWAWMKRFHLPEAEKLNRAAMIGFFMAYFVDSLTVGLVDMQGNFFCKTLLFVAVAGVLLVRKNEDIETVKKLIDETTF	234
<i>Zea mays</i>	TSIIPWWAWMKRFHLPEAEKLNRAAMIGFFMAYFVDSLTVGLVDMQGNFFCKTLLFVAVAGVLLVRKNEDIETVKKLIDETTF	227
<i>Cucumis sativus</i>	TSIIPWWAWMKRFHLPEAEKLNRAAMIGFFMAYFVDSLTVGLVDMQGNFFCKTLLFVAVAGVLLVRKNEDIETVKKLIDETTF	247
<i>Nicotiana tabacum</i>	TSIIPWWAWMKRFHLPEAEKLNRAAMIGFFMAYFVDSLTVGLVDMQGNFFCKTLLFVAVAGVLLVRKNEDIETVKKLIDETTF	231
AtLIL3:2	TSIIPWWAWMKRFHLPEAEKLNRAAMIGFFMAYFVDSLTVGLVDMQGNFFCKTLLFVAVAGVLLVRKNEDIETVKKLIDETTF	237
AtLIL3:1	TSIIPWWAWMKRFHLPEAEKLNRAAMIGFFMAYFVDSLTVGLVDMQGNFFCKTLLFVAVAGVLLVRKNEDIETVKKLIDETTF	240
<i>Chlamydomonas reinhardtii</i>	TSIIPWWAWMKRFHLPEAEKLNRAAMIGFFMAYFVDSLTVGLVDMQGNFFCKTLLFVAVAGVLLVRKNEDIETVKKLIDETTF	228
OsLIL3	YDKQWQATWQDESPTS..QPKK.	250
<i>Hordeum vulgare</i>	YDKQWQSTWQDDSTS..GPKK.	253
<i>Zea mays</i>	YDKQWQATWQDDPTE..GPKN.	246
<i>Cucumis sativus</i>	YDKQWQATWQDETSG..SGKM.	266
<i>Nicotiana tabacum</i>	YDKQWQAAMKDETS..SSKES	251
AtLIL3:2	YDKQWQAAMKEPDSSTVSSKK.	258
AtLIL3:1	YDKQWQAAMKNDDESLSGSKK.	262
<i>Chlamydomonas reinhardtii</i>	YDKQWQAAMKNDDESLSGSKK.	249

Additional file 8: Figure S4. Sequence alignment of OsLIL3 and its homologues. Identical residues are boxed in black, and similar residues ($\geq 75\%$ identical) are highlighted in gray. A black underline indicates the putative chloroplast signal peptides, a red arrow shows the mutant site of 637ys, and green underlines represent the transmembrane helices predicted by HMMTOP. The blue box shows the LHC motif based on the sequence of LHC motif. The red box shows the 11 new amino acids in the mutant Os1i3 protein. GenBank accession numbers for the respective protein sequences are as Fig. 5.