

Fig. S1

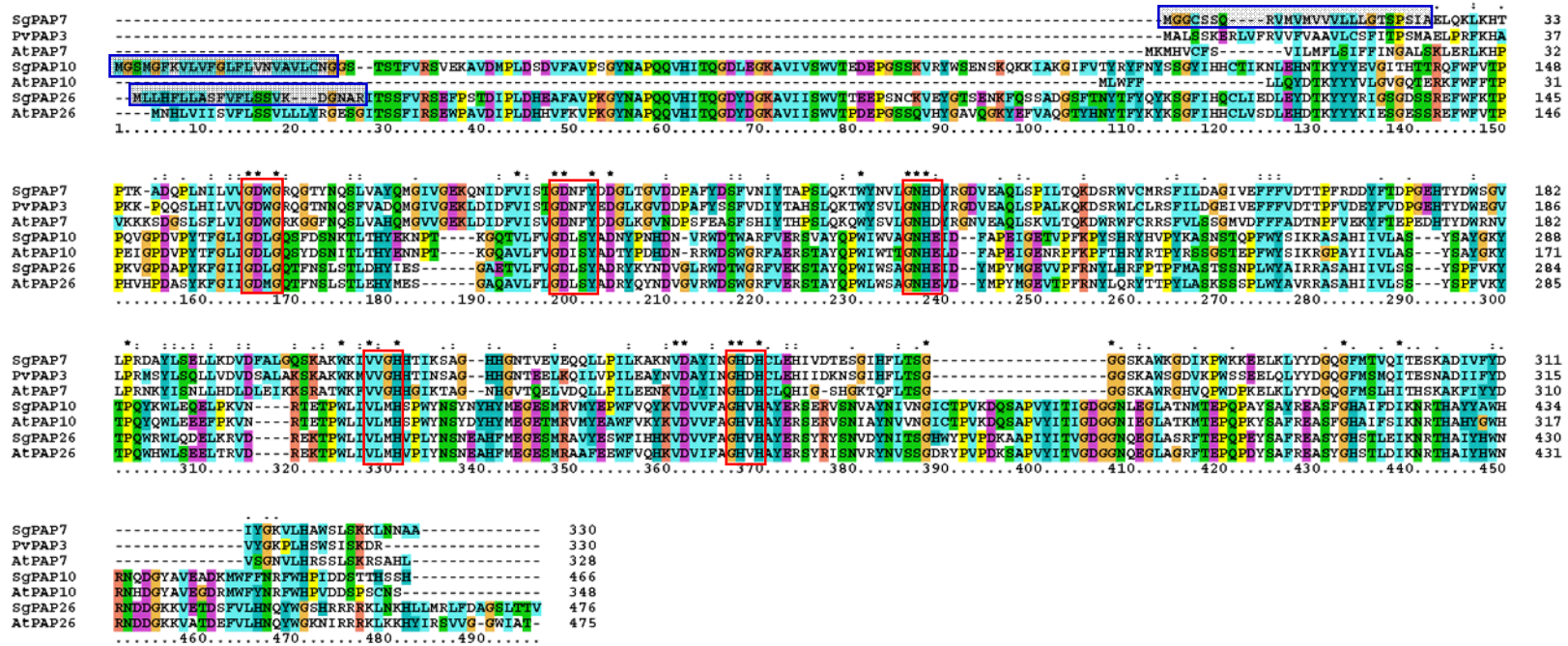
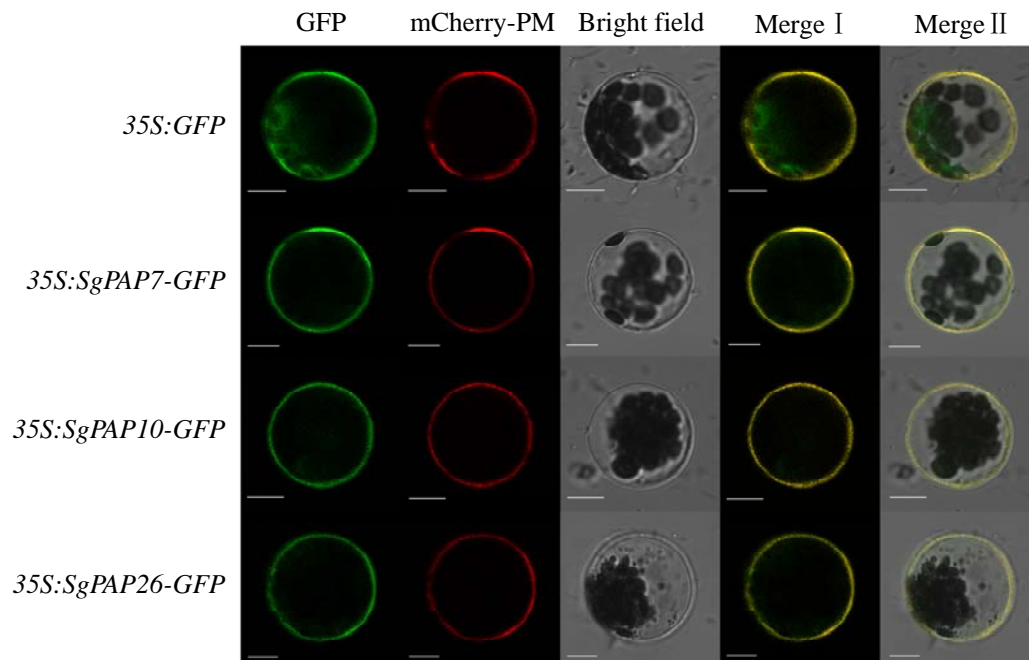


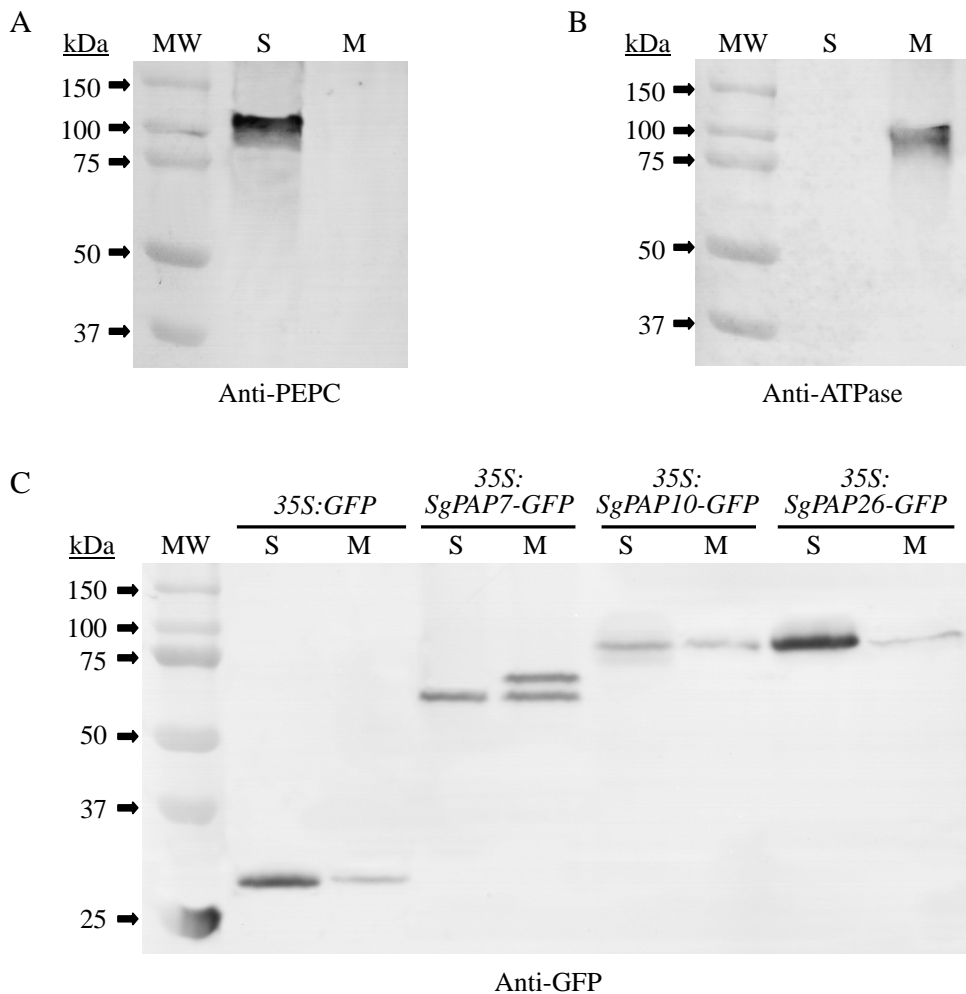
Fig. S1 Multiple sequence alignment of three SgPAPs and orthologous plant PAPs. Red boxes indicate positions of conserved sequence motifs of PAP. Putative signal peptide cleavage sites for SgPAP7, SgPAP10 and SgPAP26 are indicated by blue boxes.

**Fig. S2**



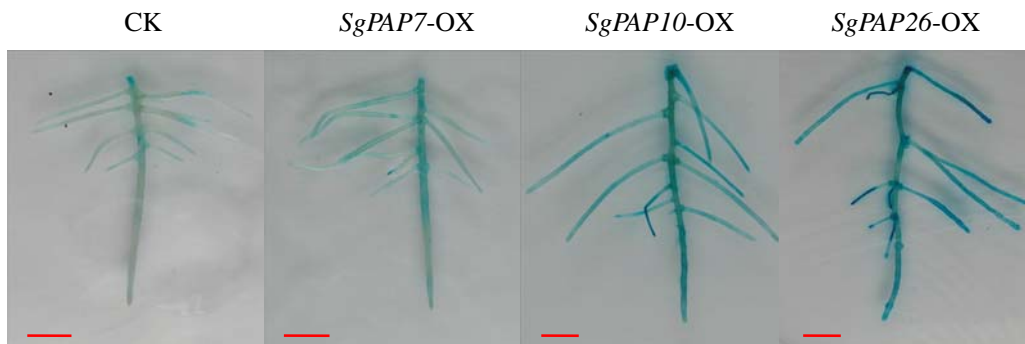
**Fig. S2** Subcellular localization of SgPAPs in Arabidopsis mesophyll protoplasts. Protoplasts were transiently co-transfected with the plasma membrane marker (mCherry-PM), along with the empty vector control or SgPAP-GFP. GFP fluorescence is shown in green and mCherry fluorescence in red. The Merge I images show a merged view of both fluorescence channels. Merge II images include the fluorescent signal panels and the bright field channels. Bars =10  $\mu$ m.

**Fig. S3**



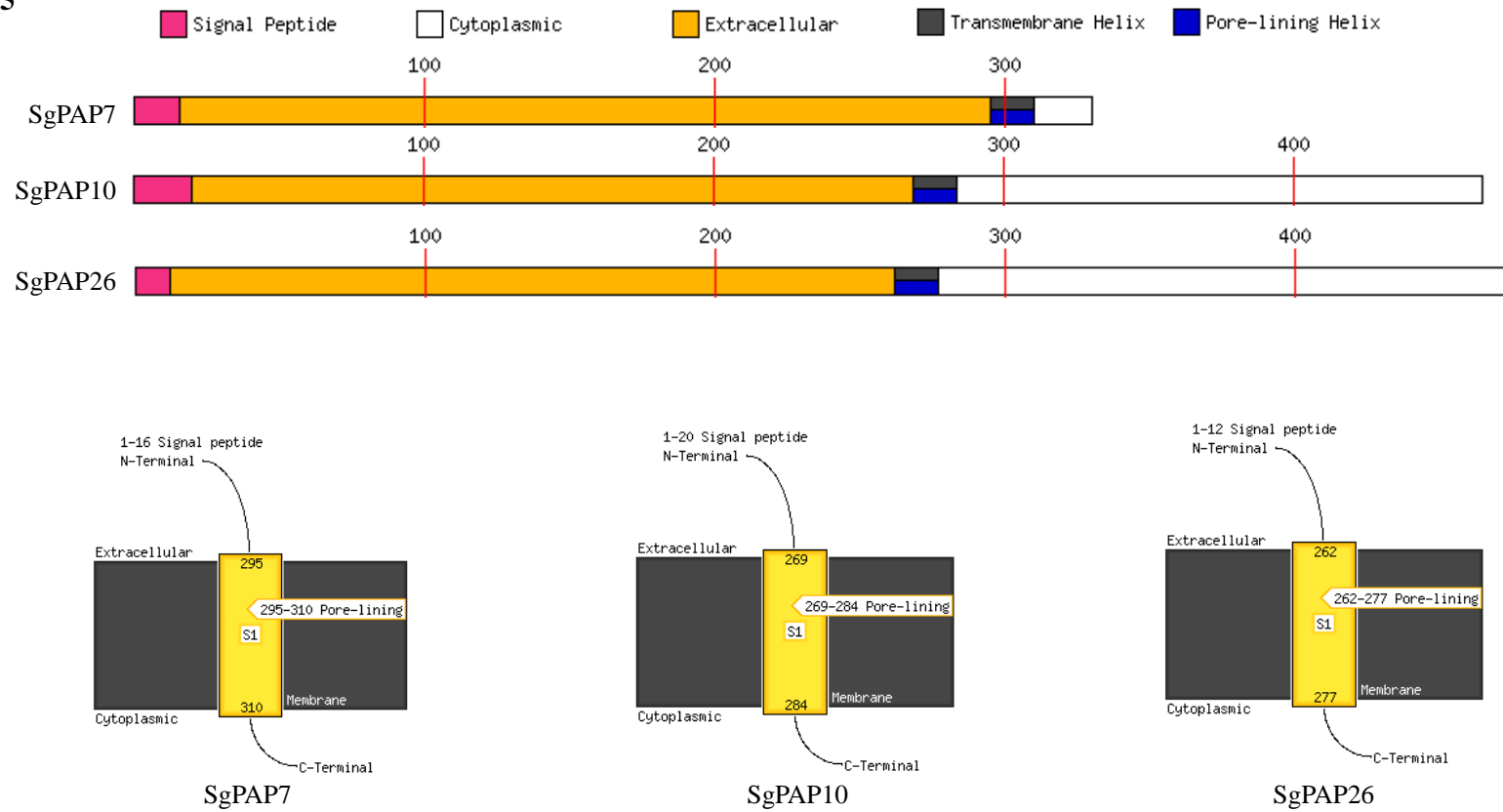
**Fig. S3** Western-blot analysis of soluble protein and membrane protein extracts from transgenic bean hairy roots. Soluble proteins and membrane proteins extracted from control lines were subjected to immunoblot analysis using anti-PEPC antibody (A) and anti-ATPase antibody (B). Immunoblotting was also performed for soluble protein and membrane protein extracts from control lines or *SgPAP-GFP* overexpression lines using anti-GFP antibody (C). Totally, 25  $\mu$ g soluble proteins and 10  $\mu$ g membrane proteins were separately loaded for each lanes. MW indicates molecular mass standards. S and M represent soluble proteins and membrane proteins, respectively.

**Fig. S4**



**Fig. S4** Histochemical staining of root-associated APase activities in bean hairy roots using BCIP as the substrate. Hairy roots were evenly overlaid with BCIP agar solution for 2 h. Bars =0.5 cm. Transgenic hairy roots cultivated on +P (1.2 mM  $\text{KH}_2\text{PO}_4$ ) MS medium were used for staining of root-associated APase activities. CK indicates transgenic bean hairy roots transformed with the empty vector. *SgPAP7-OX*, *SgPAP10-OX* and *SgPAP26-OX* indicate transgenic hairy roots overexpressing *SgPAP7*, *SgPAP10* and *SgPAP26*, respectively.

**Fig. S5**



**Fig. S5** Prediction of SgPAP trans-membrane topology. Trans-membrane helices of SgPAPs were predicted by MEMSAT-SVM ([http://bioinf.cs.ucl.ac.uk/web\\_servers/](http://bioinf.cs.ucl.ac.uk/web_servers/)).

**Table S1** A list of primers used in the study

Primer name	Sequence (5' - 3')
<i>SgPAP7</i> -EST-F	GTTGATGATCCAGCATTCTAC
<i>SgPAP7</i> -EST-R	GGTCATGTCCATTTATGTATGC
<i>SgPAP10</i> -EST-F	TGGTCTCATTGGGGATCTTG
<i>SgPAP10</i> -EST-R	GCTGTGGTTCTGTTCATGTTGGT
<i>SgPAP26</i> -EST-F	CAAGGTGACTATGATGGAAAAGC
<i>SgPAP26</i> -EST-R	CGCATGCTTTCCACCCTCCAT
RACE-UPM	CTAATACGACTCACTATAGGGCAAGCAGTGGTATCAACGCAGAGT
RACE-NUP	AAGCAGTGGTATCAACGCAGAGT
<i>SgPAP7</i> -5'-RACE-R	GGTATGCTCTCCCGGGTCCGTAAAGT
<i>SgPAP7</i> -3'-RACE-F	CTTGATGCAGGCATTGTGGAATTCTTC
<i>SgPAP10</i> -5'-RACE-R	CCAAGGCGAATGCATGAGCACAATC
<i>SgPAP10</i> -3'-RACE-F	GGATTTGGGTTGCAGGGAACCATG
<i>SgPAP26</i> -5'-RACE-R	CACGTATCCCACCGCAGACCAACATC
<i>SgPAP26</i> -3'-RACE-F	CTCCTGGGTGACAACAGAAGAACCAAG
<i>SgPAP7</i> -RT-F	CAGCAACTCCTTCCCATCCTAAAG
<i>SgPAP7</i> -RT-R	ATCCACCTCCGCTTGTAGAAAGT
<i>SgPAP10</i> -RT -F	GCGAGAACAGCAAGCAAAAAGAAG
<i>SgPAP10</i> -RT -R	GTGTGTGTGATTCCGACTTCATAGT
<i>SgPAP26</i> -RT-F	AGCGAGTTGACAGGGAGAAGAC
<i>SgPAP26</i> -RT-R	ACCCGCAAAGACCACATCAAC
<i>SgPAP7</i> -OX-F	GAGCTCATGGGACTTCCAATAATCTCT
<i>SgPAP7</i> -OX-R	ACGCGTTCATGCTGCATTGTTAAGCTT
<i>SgPAP10</i> -OX -F	CCCAAGCTTATGGGTTCAATGGGTTTCAAAGT
<i>SgPAP10</i> -OX- R	CGACGCGTTTAATGAGAACTGTGAGTTGTGG
<i>SgPAP26</i> -OX -F	CCCAAGCTTATGTTGCTTCATTTTTTGCTAGCT
<i>SgPAP26</i> -OX -R	CGACGCGTTTAGACGGTGGTAAGACTACCAGC
<i>SgPAP7</i> -GFP -F	GCTCTAGAG ATGGGTGGGTGTTCAAGCC
<i>SgPAP7</i> -GFP -R	GGGGTACCGT TGCTGCATTGTTAAGCTTTTTGG
<i>SgPAP10</i> -GFP -F	GCTCTAGAG ATGGGTTCAATGGGTTTCAAAGT
<i>SgPAP10</i> -GFP -R	GGGGTACCGT ATGAGAACTGTGAGTTGTGGAATC
<i>SgPAP26</i> -GFP -F	GCTCTAGAG ATGTTGCTTCATTTTTTGCTAGCT
<i>SgPAP26</i> -GFP -R	GGGGTACCGT GACGGTGGTAAGACTACCAGCAT
<i>SgEF-1a</i> -F	CACTTCAGGACGTGTACAAGATC
<i>SgEF-1a</i> -R	CTTGGAGAGCTTCATGGTGCA
<i>PvEF-1a</i> -F	TGAACCACCCTGGTCAGATT
<i>PvEF-1a</i> -R	TCCAGCATCACCATTCTCA