

SUPPLEMENTARY DATA

TABLE S1. List of quantitative real-time PCR primers

Gene loci	Primer	For cDNA amplification(5' to 3')	Length (bp)
Glyma02g13070	Glyma02g13070-F	GAACAGTGGGATGGCGTGAC	20
	Glyma02g13070-R	GGAAAAGGAGGTGCGGTGA	19
Glyma02g45950	Glyma02g45950-F	TGGAGTACAAGGCTAGTTGTC	21
	Glyma02g45950-R	ATCGCTGGTTATTAAGTAACCT	22
Glyma03g35190	Glyma03g35190-F	CCAACAAGATGCTGCTAACGA	21
	Glyma03g35190-R	CAAAGAGGCCGAGTGAGATG	20
Glyma03g35200	Glyma03g35200-F	GTAACCCAAGGCAACCACGAG	21
	Glyma03g35200-R	CACGGGGCATGAATCAATACTACA	24
Glyma04g37180	Glyma04g37180-F	CAATGGGAAGGGAAAGTTT	19
	Glyma04g37180-R	TAGTCGAGAGATCCCTGTAAAGAC	24
Glyma05g03320	Glyma05g03320-F	GGTAGTGGCCTGGTTGGTCC	20
	Glyma05g03320-R	GAAGGGGTGGCTGTGATGG	19
Glyma05g26920	Glyma05g26920-F	ATCCTAACAGCTTCACGCAA	20
	Glyma05g26920-R	GCTCAAAGCTCAAATGTCAT	20
Glyma05g26930	Glyma05g26930-F	AAATGGAGGTCCCTCTGGC	19
	Glyma05g26930-R	AGGGTGCATACTACAGCTACTGC	23
Glyma05g33630	Glyma05g33630-F	TCGGCTTCTCCCTATCCTTCA	21
	Glyma05g33630-R	CGCCTCTTCGGTTCATTCT	20
Glyma05g33640	Glyma05g33640-F	TTTTTCGTGTTTCAGTGGTTGC	21
	Glyma05g33640-R	AAAGGAGTTAAAGACAGAGCGT	22
Glyma06g03100	Glyma06g03100-F	GAACACCTCAGGCTCCCAACA	21
	Glyma06g03100-R	CCAAGCAAATGGGCTCACAA	20
Glyma06g17860	Glyma06g17860-F	TCCATTATAGCAGTCCCTTTTGTG	24
	Glyma06g17860-R	TGGTTCCTCTACCCAGCCAAT	21
Glyma08g06090	Glyma08g06090-F	CTATGTAATGTTTAGAGCATTGAG	24
	Glyma08g06090-R	CACAATAACGTCTCTTGCATC	21
Glyma08g09880	Glyma08g09880-F	CTCGGGACAAGAAACAAAAGT	22
	Glyma08g09880-R	CAAACCAGATGGGGAGATGATAG	23
Glyma08g09900	Glyma08g09900-F	TTCGGCAATGCCATCC	16
	Glyma08g09900-R	TTCGCAGTTGAAAATGCTCT	20
Glyma08g09910	Glyma08g09910-F	CGTGCTACCGAAGTTTGAGA	20
	Glyma08g09910-R	TTGGGTTGCCCTGCTAA	17
Glyma08g40210	Glyma08g40210-F	GGTTTTAAGTGGCAGTTTGG	20
	Glyma08g40210-R	GCAACAATGGAGCTTTCTGA	20
Glyma08g42670	Glyma08g42670-F	GGGTCCTTGGAGTGAGTAAA	20
	Glyma08g42670-R	CCCACAACCTCGCAACAAT	18
Glyma08g46550	Glyma08g46550-F	TGGGGATGGGGGCAACAGA	19
	Glyma08g46550-R	GGCGATCCCAACAAAACCTACTCACTT	27
Glyma09g36360	Glyma09g36360-R	CACAGCCAGAGTATTCTTCATTCC	24
	Glyma09g36360-R	AGCAACTCCGTCTTGATTTCG	21

Glyma10g08300	Glyma10g08300-F	GCTGATGGTGTGTTGGATTG	19
	Glyma10g08300-R	TGTTGGGTGTCAAAGTTGAG	20
Glyma11g36510	Glyma11g36510-F	CCAGTTTCAGGCCCAAGAGC	21
	Glyma11g36510-R	CCCCAGTGCCATTAGTAAGATAGAGGTT	28
Glyma12g01000	Glyma12g01000-F	AAGATGGAGTTGCTGTGGAG	20
	Glyma12g01000-R	GTGAAACATGAGCAGTGGAAT	21
Glyma12g34960	Glyma12g34960-F	CAGATACTGGCATCCTGTTGA	21
	Glyma12g34960-R	AACTGACACCGAGGGCAAC	19
Glyma13g23090	Glyma13g23090-F	AACCAGTATTGGGGAAGCA	19
	Glyma13g23090-R	CGCTCGGAGACTATTGAACTA	21
Glyma13g35610	Glyma13g35610-F	TCTTCCGAATGTGGCTGTGG	20
	Glyma13g35610-R	GCCTGAAGGGGAAACAAATACA	22
Glyma14g02790	Glyma14g02790-F	CTCAGAACTACGTGGATTAGC	21
	Glyma14g02790-R	CATGCACCAGCACAACC	17
Glyma17g11790	Glyma17g11790-F	ATTGATGAAGTTGCCAGCATG	21
	Glyma17g11790-R	GCATTTGCTCACTCAGACAC	21
Glyma18g00410	Glyma18g00410-F	AACCCATGCACTGTGGATTTG	21
	Glyma18g00410-R	GCTTGATTGGTGGCAGTTTT	21
Glyma18g17580	Glyma18g17580-F	TCAGATGATGACGAATGGGATG	22
	Glyma18g17580-R	GGCAGGTGGAAGCATTGAAGT	21
Glyma19g03220	Glyma19g03220-F	GATGGGATGGGTGGGGAAGTTTAT	25
	Glyma19g03220-R	CCAAGGGGTTACACTACGGTCTACT	27
Glyma19g37850	Glyma19g37850-F	TACAGGTGCGGAGGGTCAGGT	21
	Glyma19g37850-R	TTGGGAATCGGCATAGGATAGGT	23
Glyma19g37860	Glyma19g37860-F	CGCCCCGTGGTACAACCTCTAA	21
	Glyma19g37860-R	GCCCTGCAAAAACAACATCAAC	22
Glyma20g01470	Glyma20g01470-F	GGTCAAGGTTTCATGTCTGTT	21
	Glyma20g01470-R	TGGACTTAGTCACTTTCCAATG	22
Glyma20g03260	Glyma20g03260-F	TGTGAGATTTCCACTCGTTT	20
	Glyma20g03260-R	GTGTATGGTCTCATCCAACA	20

TABLE S2. Domain organization of the 35 GmPAPs

Gene loci	Proposed name	Motif					No. of potential N-glycosylation sites	pI	Previous name
Glyma02g13070	GmPAP1	GDMG	GDICY	GNHE	–	–	4	6.21	–
Glyma02g45950	GmPAP2	GDLG	GDLSY	GNHE	VLFH	GHVH	1	5.72	–
Glyma03g35190	GmPAP3	GDLG	GDLSY	GNHE	VLLH	GHVH	1	5.45	–
Glyma03g35200	GmPAP4	GDLG	GDLSY	GNHE	VLIH	GHVH	3	6.00	–
Glyma04g37180	GmPAP5	GAFN	EDMPY	GNHE	FSAH	GHVH	1	5.33	–
Glyma05g03320	GmPAP6	GDMG	GDLTY	GNHE	FAAH	GHVH	4	5.91	–
Glyma05g26920	GmPAP7	TKWS	DDPAF	GNHD	VVGH	GQDH	0	6.60	–
Glyma05g26930	GmPAP8	GDWG	GDNFY	GNHD	VVGH	GHDH	2	5.41	–
Glyma05g33630	GmPAP9	GDWG	GDNFY	GNHD	VVGH	GHDH	1	5.72	–
Glyma05g33640	GmPAP10	GDWG	GDNFY	GNHD	VVGH	GHDH	1	6.41	–
Glyma06g03100	GmPAP11	GDLG	GDLSY	GNHE	VLMH	GHVH	10	6.19	–
Glyma06g17860	GmPAP12	GDMG	GDMPY	GNHE	FSAH	GHVH	5	5.80	–
Glyma08g06090	GmPAP13	GDWG	GDNFY	GNHD	VVGH	GHDH	1	5.47	–
Glyma08g09880	GmPAP14	GDWG	GDNFY	GNHD	VVGH	GHDH	2	5.40	–
Glyma08g09900	GmPAP15	GDWG	GDNFY	GNHD	VIGH	GHDH	1	6.91	GmPAP2
Glyma08g09910	GmPAP16	GDWG	GDNFY	GNHD	VVGH	GHDH	1	5.88	–
Glyma08g40210	GmPAP17	GDLG	GDLCY	GNHE	FLAH	GHVH	3	5.99	–
Glyma08g42670	GmPAP18	GDLG	GDLSY	GNHE	VLFH	GHVH	1	5.66	–
Glyma08g46550	GmPAP19	GDLG	GDVTY	GNHE	VTWH	GHVH	4	5.30	–
Glyma09g36360	GmPAP20	GDLG	GDLSY	GNHE	VLMH	GHVH	5	5.88	–
Glyma10g08300	GmPAP21	GDLG	GDLSY	GNHE	ALLH	GHVH	2	6.02	–
Glyma11g36510	GmPAP22	GDLG	GDVSY	GNHE	ATWH	GHVH	6	4.77	–
Glyma12g01000	GmPAP23	GDLG	GDLSY	GNHE	VLMH	GHVH	5	6.05	GmPAP1
Glyma12g34960	GmPAP24	GDLG	GDLSY	GNHE	VLVH	GHVH	4	6.19	–
Glyma13g23090	GmPAP25	GDLG	GDLSY	GNHE	VLVH	GHVH	2	6.29	–
Glyma13g35610	GmPAP26	GDLG	GDLSY	GNHE	VLVH	GHVH	4	6.18	–
Glyma14g02790	GmPAP27	GDLG	GDLSY	GNHE	VLFH	GHVH	1	5.69	–
Glyma17g11790	GmPAP28	GDLG	GDLSY	GNHE	VLMH	GHVH	4	8.10	GmPAP3
Glyma18g00410	GmPAP29	GDLG	GDVTY	GNHE	VTWH	GHVH	6	4.97	GmPhy
Glyma18g17580	GmPAP30	GDMG	GDLSY	GNHE	FLAH	GHVH	3	5.41	–
Glyma19g03220	GmPAP31	GDLG	GDITY	GNHE	AAWH	GHVH	5	5.34	–
Glyma19g37850	GmPAP32	GDLG	GDLSY	GNHE	VLLH	GHVH	1	5.21	–
Glyma19g37860	GmPAP33	GDLG	GDLSY	GNHE	VLIH	GHVH	1	6.19	–
Glyma20g01470	GmPAP34	GDWG	GDNFY	GNHD	AVGH	GHDH	3	9.31	–
Glyma20g03260	GmPAP35	GDMG	GDISY	GNHE	VQGH	GHVH	6	5.89	–

TABLE S3. Expression specificity of *GmPAP* genes across six different tissues under normal P treatments

Gene loci	Proposed name	Root	Stem	Leaf	Flower	Pod	Seed
Glyma02g13070	GmPAP1			+			
Glyma02g45950	GmPAP2						
Glyma03g35190	GmPAP3						
Glyma03g35200	GmPAP4						
Glyma04g37180	GmPAP5						
Glyma05g03320	GmPAP6			+			
Glyma05g26920	GmPAP7	+++					
Glyma05g26930	GmPAP8	+					
Glyma05g33630	GmPAP9						
Glyma05g33640	GmPAP10				+		
Glyma06g03100	GmPAP11						++++
Glyma06g17860	GmPAP12						
Glyma08g06090	GmPAP13				+		
Glyma08g09880	GmPAP14						++
Glyma08g09900	GmPAP15						
Glyma08g09910	GmPAP16				+		
Glyma08g40210	GmPAP17		+				
Glyma08g42670	GmPAP18					+	
Glyma08g46550	GmPAP19						
Glyma09g36360	GmPAP20						
Glyma10g08300	GmPAP21	+++					
Glyma11g36510	GmPAP22						
Glyma12g01000	GmPAP23			+			
Glyma12g34960	GmPAP24						
Glyma13g23090	GmPAP25				+		
Glyma13g35610	GmPAP26						
Glyma14g02790	GmPAP27						
Glyma17g11790	GmPAP28						
Glyma18g00410	GmPAP29						
Glyma18g17580	GmPAP30						++
Glyma19g03220	GmPAP31						
Glyma19g37850	GmPAP32				+		
Glyma19g37860	GmPAP33						+
Glyma20g01470	GmPAP34				++++		
Glyma20g03260	GmPAP35						

The fold-change of the expression of the *GmPAP* genes were calculated, and the expressions were then classified into four groups according to their tissue specificity, denoted as follows: +, preferentially (≥ 2 - and < 5 -fold changes between the expression levels of the most highly expressed and second most highly expressed genes); ++, specifically (≥ 5 - and < 10 -fold changes); +++, very specifically (≥ 10 - and < 25 -fold changes); and +++, exclusively identified in one tissue (≥ 25 -fold change) (Libault *et al.*, 2010. *The Plant Journal* **63**: 86–99).

TABLE S4. Quantitative real-time PCR analysis of expression levels of the *GmPAP* genes in different soybean tissues under different P treatments. Relative expression values are given.

Proposed name	Root		Stem		Leaf		Flower		Pod		Seed	
	LP	HP	LP	HP	LP	HP	LP	HP	LP	HP	LP	HP
<i>GmPAP1</i>	0.87±0.13	0.11±0.03	0.54±0.14	0.12±0.02	2.10±0.18	0.50±0.10	0.09±0.02	0.08±0.01	0.05±0.02	0.06±0.02	0.04±0.01	0.04±0.02
<i>GmPAP2</i>	0.91±0.08	0.99±0.14	1.73±0.28	0.67±0.07	0.83±0.15	0.41±0.10	0.70±0.04	0.81±0.18	0.77±0.09	0.70±0.08	0.30±0.01	0.71±0.05
<i>GmPAP3</i>	3.40±0.02	0.01±0.01	0.19±0.04	0.16±0.11	1.99±0.69	0.52±0.22	1.21±0.14	0.27±0.09	0.07±0.04	0.03±0.02	0.13±0.12	0.13±0.07
<i>GmPAP4</i>	7.81±1.26	0.67±0.39	5.97±2.10	0.48±0.16	12.37±1.17	0.66±0.18	15.84±0.25	4.22±0.87	0.37±0.21	0.09±0.08	12.46±2.50	5.94±5.93
<i>GmPAP5</i>	0.73±0.08	0.83±0.06	0.91±0.25	0.38±0.06	1.33±0.09	1.22±0.08	0.69±0.12	1.16±0.19	0.56±0.07	0.89±0.13	0.48±0.10	0.33±0.12
<i>GmPAP6</i>	0.47±0.14	0.46±0.05	0.22±0.03	0.10±0.01	1.55±0.09	1.07±0.03	0.43±0.06	0.38±0.08	0.39±0.10	0.23±0.00	0.24±0.03	0.29±0.10
<i>GmPAP7</i>	3.02±0.30	4.06±1.18	0.46±0.22	0.17±0.09	0.13±0.08	0.03±0.02	0.12±0.07	0.13±0.05	0.17±0.10	0.18±0.07	0.15±0.10	0.04±0.04
<i>GmPAP8</i>	10.49±3.10	3.33±0.58	1.46±0.47	0.48±0.11	0.71±0.38	0.07±0.02	0.58±0.28	0.99±0.15	0.10±0.06	0.09±0.04	0.03±0.01	0.06±0.05
<i>GmPAP9</i>	0.77±0.09	0.05±0.02	0.61±0.19	0	1.92±0.18	0.01±0.01	0.42±0.07	0.04±0.01	0.18±0.05	0	0.10±0.02	0.06±0.02
<i>GmPAP10</i>	6.17±0.18	0.10±0.05	0.23±0.16	0.08±0.02	3.22±0.68	0.16±0.04	2.63±0.56	0.61±0.26	0.41±0.10	0.11±0.04	0.97±0.33	0.29±0.16
<i>GmPAP11</i>	0.14±0.14	0.05±0.01	0.03±0.02	0	0.06±0.02	0	0.01±0.00	0.02±0.01	0	0	0	2.14±0.51
<i>GmPAP12</i>	0.06±0.02	0.02±0.00	0.56±0.16	0.01±0.01	1.99±0.11	0.29±0.05	0.79±0.26	0.30±0.06	0.05±0.02	0.08±0.02	0.02±0.01	0.03±0.02
<i>GmPAP13</i>	1.14±0.05	0.01±0.00	0.77±0.18	0.02±0.01	1.21±0.08	0	0.52±0.07	0.15±0.09	0.47±0.02	0.02±0.00	0.18±0.03	0.06±0.02
<i>GmPAP14</i>	133.24±42.54	107.16±42.70	29.17±11.87	20.96±3.94	75.78±25.42	4.01±2.50	9.63±2.80	10.90±0.84	0.78±0.78	8.68±2.04	7.62±3.54	805.79±248.70
<i>GmPAP15</i>	2.68±0.30	0	0.17±0.11	0.23±0.07	4.22±0.36	0.89±0.03	0.34±0.09	0.63±0.58	0.39±0.06	0.63±0.13	0.02±0.01	1.16±0.22
<i>GmPAP16</i>	0.51±0.01	0.03±0.01	0.02±0.01	0.02±0.01	0.12±0.01	0.04±0.01	0.47±0.03	0.09±0.00	0.05±0.01	0.01±0.01	0	0
<i>GmPAP17</i>	6.27±0.82	0	0.84±0.34	1.27±0.22	1.26±0.29	0.57±0.17	1.13±0.07	0.63±0.20	0.22±0.04	0.47±0.10	0.17±0.09	0.11±0.03
<i>GmPAP18</i>	1.42±0.77	0.26±0.13	2.38±0.13	1.32±0.07	1.09±0.40	1.24±0.12	0.86±0.02	0.34±0.07	1.49±0.30	3.02±0.19	0.37±0.19	0
<i>GmPAP19</i>	0.99±0.06	0.80±0.05	1.26±0.11	0.44±0.05	0.22±0.01	0.22±0.05	0.68±0.04	0.64±0.04	0.73±0.10	0.40±0.03	0.68±0.09	0.76±0.17
<i>GmPAP20</i>	3.23±0.45	0.10±0.01	0.90±0.19	0.05±0.01	1.42±0.12	0.23±0.03	0.57±0.03	0.19±0.06	0.21±0.03	0.13±0.01	0.09±0.01	0.17±0.07
<i>GmPAP21</i>	37.72±7.32	2.14±0.82	0.19±0.19	0.05±0.03	0.12±0.02	0.02±0.01	0.67±0.35	0.15±0.03	0.45±0.17	0.12±0.11	0	0
<i>GmPAP22</i>	0.20±0.07	0.15±0.05	0.12±0.05	0.10±0.05	0.11±0.10	0.44±0.13	1.80±0.35	1.30±0.29	0.13±0.03	0.40±0.09	1.19±0.48	1.09±0.10
<i>GmPAP23</i>	0.53±0.05	0.01±0.01	0.20±0.08	0.01±0.00	0.34±0.06	0.05±0.01	0.09±0.03	0.02±0.01	0.02±0.01	0.02±0.01	0.01±0.00	0.02±0.01
<i>GmPAP24</i>	0	0.08±0.04	0.04±0.02	0.02±0.01	0	0	0.01±0.00	0	0.01±0.01	0.11±0.10	0.47±0.31	0
<i>GmPAP25</i>	2.6±0.41	0.04±0.04	30.97±0.18	2.31±0.21	31.67±1.26	2.98±0.46	11.42±0.46	6.80±0.88	2.98±0.50	3.37±0.45	0.30±0.15	0.12±0.05

<i>GmPAP26</i>	0.11±0.07	0.37±0.08	1.05±0.18	1.50±0.05	0.34±0.10	0.46±0.17	0.67±0.09	0.89±0.04	0.29±0.05	0.74±0.14	1.33±0.11	1.99±0.43
<i>GmPAP27</i>	3.79±0.67	1.50±0.24	4.95±1.07	1.12±0.24	2.03±0.54	0.75±0.29	1.74±0.19	2.08±0.05	0.76±0.22	1.05±0.22	0.55±0.09	0
<i>GmPAP28</i>	1.64±0.19	0.69±0.06	2.10±0.4	0.68±0.07	1.91±0.03	0.89±0.09	1.40±0.16	1.01±0.08	0.87±0.15	1.30±0.21	0.33±0.04	0.13±0.08
<i>GmPAP29</i>	0.31±0.07	0.30±0.05	0.14±0.04	0.27±0.04	0.11±0.03	0.36±0.07	1.44±0.11	1.02±0.10	0.33±0.10	0.72±0.08	1.07±0.11	2.03±0.75
<i>GmPAP30</i>	0.33±0.19	0.13±0.03	0.17±0.07	0.16±0.07	0.39±0.09	0.14±0.02	0.12±0.04	0.10±0.03	0.05±0.01	0.16±0.08	0.25±0.17	1.17±0.49
<i>GmPAP31</i>	2.56±1.3	0	9.35±3.62	0.98±0.32	5.65±0.99	2.54±0.46	6.45±0.97	1.39±0.48	2.61±0.79	1.32±0.92	0.40±0.26	0.02±0.01
<i>GmPAP32</i>	0.70±0.08	0.03±0.01	0.94±0.23	0.04±0.01	2.91±0.06	0.04±0.01	0.50±0.01	0.14±0.02	0.04±0.02	0.01±0.00	0.03±0.01	0.02±0.01
<i>GmPAP33</i>	0.54±0.09	0.04±0.01	0.60±0.29	0.02±0.01	1.68±0.59	0.01±0.01	1.08±0.22	0.31±0.05	0.19±0.03	0.05±0.01	0.64±0.08	0.76±0.10
<i>GmPAP34</i>	0.13±0.06	0.12±0.02	0.01±0.00	0.02±0.01	0.63±0.24	0	4.50±0.99	4.20±0.74	0.04±0.04	0.09±0.04	0.03±0.02	0.03±0.01
<i>GmPAP35</i>	4.69±1.22	0.78±0.31	0.79±0.15	0.73±0.08	1.37±0.33	0.50±0.05	1.23±0.26	0.57±0.18	1.31±0.21	0.85±0.21	0.35±0.08	0.35±0.27
