**Supplementary materials**

**Table S1** Primers used for reverse transcription quantitative PCR (RT-qPCR)

|  |  |  |  |
| --- | --- | --- | --- |
| Gene | Forward primer (5’ to 3’) | Reverse primer (5’ to 3’) | Product size (bp) |
| *PSY* (c44107\_g3) | CTCGATGCTGCTTTATCCG | TGTGATATAGGTGCAATTCCC | 200 |
| *PDS* (c45204\_g2) | GTATTAATGACCGATTGCAG | TTCAACATAGGCTTGTCCA | 221 |
| *ZDS* (c44360\_g2) | ATTTATATGCTTGAGTTATGC | CATTGTGCATCTAGGGTCTGT | 203 |
| *Z-ISO* (c42205\_g2) | AATTCGATTTCGCCAAGCAGA | CTAGCCAAGCCACTATGGAC | 214 |
| *CCD4* (c41052\_g1) | AATCCAGCTTTCGTCGCTA | CATCGTCCTCCTTCGCATT | 220 |
| *CCD7* (c36484\_g1) | AAGTTATTGCCTCGCCTTGTT | TCACCACTGTATCAAACGGAA | 217 |
| *AAO3* (c38672\_g1) | AAGATTTAGGAGCACCCAT | CTTCATCTGGAACCGCAAG | 213 |
| *UGT75C1* (c45978\_g1) | AACCTAGAGCAAGATCCGAAC | AACCATCTTGTTTCCGGTCCA | 232 |
| *CHS2* (c43287\_g4) | AGGTGGAGATTAAGCTGGGAC | CACCACAGTCTCAACAGTCAG | 215 |
| *CHLG* (c41769\_g1) | CCGACATCTAACTGCATCCAT | GCTTTGTAAGCTGAACACGAA | 218 |
| *Actin* (KY114518.1) | GCAAGTTATTACTATCGGAGCA | CCACTAAGCACAATGTTACCA | 168 |

**Table S2** Color parameters in GB\_Pe, WF\_Pe, and YF\_Pe

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Group | parameters | Sample 1 | | | Sample 2 | | | Sample 3 | | | Sample 4 | | | Sample 5 | | | Mean | SD |
| GB\_Pe | L | 51.82 | 50.15 | 51.74 | 52.55 | 52.98 | 52.69 | 52.68 | 53.37 | 53.36 | 52.08 | 51.92 | 51.40 | 52.10 | 52.37 | 52.00 | 52.21 | 0.81 |
| a | -12.22 | -12.46 | -12.41 | -12.27 | -12.13 | -12.20 | -12.14 | -12.14 | -12.22 | -13.20 | -13.23 | -13.07 | -11.94 | -11.87 | -11.95 | -12.36 | 0.45 |
| b | 28.75 | 27.78 | 28.33 | 28.43 | 28.84 | 28.71 | 28.31 | 28.89 | 28.98 | 29.73 | 29.81 | 28.73 | 27.27 | 27.20 | 26.95 | 28.45 | 0.85 |
| c | 31.24 | 30.45 | 30.93 | 30.96 | 31.28 | 31.20 | 30.81 | 31.34 | 31.45 | 32.53 | 32.61 | 31.56 | 29.77 | 29.68 | 29.48 | 31.02 | 0.91 |
| h | 113.02 | 114.15 | 113.66 | 113.35 | 112.81 | 113.03 | 113.22 | 112.78 | 112.87 | 113.94 | 113.93 | 114.47 | 113.65 | 113.58 | 113.92 | 113.49 | 0.53 |
| WF\_Pe | L | 80.87 | 81.18 | 79.53 | 84.60 | 80.42 | 81.96 | 85.30 | 81.60 | 83.66 | 82.44 | 84.25 | 81.57 | 83.21 | 84.05 | 81.40 | 82.40 | 1.69 |
| a | -0.40 | -0.26 | -0.99 | -0.58 | -0.30 | -0.43 | -0.98 | -0.40 | -0.35 | -0.64 | -0.62 | -1.02 | -0.54 | -0.42 | -0.72 | -0.58 | 0.25 |
| b | 13.26 | 13.60 | 13.32 | 13.47 | 12.83 | 13.49 | 17.19 | 14.99 | 16.45 | 14.62 | 17.07 | 13.35 | 14.76 | 14.38 | 15.24 | 14.53 | 1.43 |
| c | 13.26 | 13.61 | 13.36 | 13.51 | 12.83 | 13.50 | 17.31 | 15.00 | 16.50 | 14.64 | 17.13 | 13.35 | 14.90 | 14.52 | 15.30 | 14.58 | 1.45 |
| h | 88.28 | 88.90 | 85.75 | 94.32 | 88.64 | 91.85 | 96.57 | 92.86 | 94.68 | 92.51 | 94.69 | 89.64 | 94.33 | 91.20 | 89.70 | 91.59 | 3.05 |
| YF\_Pe | L | 78.78 | 79.47 | 79.69 | 77.59 | 76.77 | 75.32 | 77.54 | 77.60 | 77.39 | 73.60 | 77.75 | 77.03 | 77.34 | 77.20 | 76.59 | 77.31 | 1.50 |
| a | 0.35 | 0.62 | 0.63 | 1.49 | 1.76 | 1.92 | 0.86 | 0.63 | 0.89 | 2.64 | 2.41 | 2.18 | 0.86 | 0.63 | 0.89 | 1.25 | 0.75 |
| b | 48.04 | 48.24 | 47.26 | 43.78 | 41.34 | 40.39 | 38.14 | 39.15 | 36.95 | 40.61 | 42.40 | 44.68 | 42.51 | 44.13 | 40.70 | 42.55 | 3.47 |
| c | 48.05 | 48.24 | 47.26 | 43.80 | 41.38 | 40.44 | 38.15 | 39.15 | 36.96 | 40.70 | 42.47 | 44.73 | 42.53 | 44.17 | 40.72 | 42.58 | 3.47 |
| h | 89.59 | 89.26 | 89.24 | 91.95 | 92.43 | 92.72 | 88.70 | 89.07 | 88.62 | 86.28 | 86.75 | 87.21 | 89.70 | 90.05 | 88.90 | 89.36 | 1.90 |

**Table S3** Differentially‐accumulated flovonoids in WF\_Pe vs GB\_Pe, YF\_Pe vs GB\_Pe and/or YF\_Pe vs WF\_Pe

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Compounds | Class | WF\_Pe vs GB\_Pe | | | YF\_Pe vs GB\_Pe | | | YF\_Pe vs WF\_Pe | | |
| VIP | Fold change | Log2FC | VIP | Fold change | Log2FC | VIP | Fold change | Log2FC |
| Chrysin O-malonylhexoside | Flavone | 1.53 | 2.61 | 1.39 | 1.68 | 7.53 | 2.91 | 1.34 | 2.88 | 1.53 |
| Kaempferide | Flavonol | 1.07 | 5.97 | 2.58 | 1.07 | 6.84 | 2.77 | - | - | - |
| Tricin 7-O-acetylglucoside | Flavone | 2.48 | 0.00 | -13.77 | - | - | - | 3.92 | 7403.70 | 12.85 |
| Chrysin O-hexoside | Flavone | - | - | - | 1.04 | 6.12 | 2.61 | 1.39 | 3.08 | 1.62 |
| Luteolin 6-C-glucoside | Flavone | 1.02 | 0.43 | -1.21 | - | - | - | - | - | - |
| Tricin 4'-O-(β-guaiacylglyceryl) ether-O-rutinoside | Flavone | - | - | - | 2.45 | 25333.33 | 14.63 | 4.18 | 25333.33 | 14.63 |
| O-methylChrysoeriol 7-O-hexoside | Flavone | 2.66 | 59185.19 | 15.85 | 2.74 | 316296.30 | 18.27 | 1.70 | 5.34 | 2.42 |
| C-hexosyl-chrysoeriol O-hexoside | Flavone | 2.64 | 53592.59 | 15.71 | 2.65 | 147777.78 | 17.17 | 1.30 | 2.76 | 1.46 |
| Cyanidin O-malonyl-malonylhexoside | Anthocyanins | - | - | - | 2.33 | 0.00 | -13.25 | 3.96 | 0.00 | -13.13 |
| Syringetin 5-O-hexoside | Flavone | 1.03 | 5.23 | 2.39 | - | - | - | 1.19 | 0.44 | -1.19 |
| Apigenin O-hexosyl-O-pentoside | Flavone | 1.06 | 5.70 | 2.51 | - | - | - | - | - | - |
| Apigenin O-malonylhexoside | Flavone | 2.56 | 27703.70 | 14.76 | 2.57 | 67888.89 | 16.05 | 1.23 | 2.45 | 1.29 |
| Syringetin 7-O-hexoside | Flavone | 1.43 | 10.45 | 3.38 | 1.22 | 5.18 | 2.37 | 1.09 | 0.50 | -1.01 |
| C-hexosyl-isorhamnetin O-hexoside | Flavone | - | - | - | - | - | - | 1.88 | 3.05 | 1.61 |
| 8-C-hexosyl chrysoeriol O-hexoside | Flavone | 2.68 | 71296.30 | 16.12 | 2.56 | 65074.07 | 15.99 | - | - | - |
| Tricin 5-O-hexosyl-O-hexoside | Flavone | 1.04 | 5.42 | 2.44 | 1.07 | 6.85 | 2.78 | - | - | - |
| Tricin 7-O-hexosyl-O-hexoside | Flavone | 1.11 | 6.78 | 2.76 | 1.10 | 7.74 | 2.95 | - | - | - |
| Tricin 5-O-β-guaiacylglycerol | Flavone | 2.51 | 0.00 | -14.13 | 2.41 | 0.00 | -14.13 | - | - | - |
| Hesperetin O-hexosyl-O-hexoside | Flavanone | 1.08 | 6.16 | 2.62 | 1.12 | 8.30 | 3.05 | - | - | - |
| Apigenin O-hexosyl-O-rutinoside | Flavone | 1.18 | 8.64 | 3.11 | 1.01 | 5.66 | 2.50 | - | - | - |
| Chrysoeriol 7-O-hexoside | Flavone | 2.66 | 59185.19 | 15.85 | 1.11 | 8.13 | 3.02 | - | - | - |
| Isorhamnetin O-acetyl-hexoside | Flavonol | - | - | - | 1.01 | 5.52 | 2.47 | - | - | - |
| Luteolin C-hexoside | Flavone | - | - | - | 1.45 | 0.34 | -1.55 | 1.22 | 0.48 | -1.07 |
| Tricin 4'-O-(syringyl alcohol) ether 5-O-hexoside | Flavone | 1.43 | 12.53 | 3.65 | 1.34 | 11.02 | 3.46 | - | - | - |
| 4'-Hydroxy-5,7-dimethoxyflavanone | Flavanone | - | - | - | - | - | - | 1.07 | 0.47 | -1.09 |
| Luteolin | Flavone | 1.10 | 0.15 | -2.74 | - | - | - | - | - | - |
| Quercetin | Flavonol | 1.04 | 0.18 | -2.44 | - | - | - | 1.32 | **2.75** | 1.46 |
| Catechin | Polyphenol | 1.34 | 0.06 | -4.03 | 1.13 | 0.12 | -3.12 | - | - | - |
| Kaempferol 7-O-rhamnoside | Flavonol | - | - | - | 1.08 | 7.17 | 2.84 | 1.12 | 2.06 | 1.05 |
| Chrysin | Flavone | - | - | - | 1.00 | 5.46 | 2.45 | 1.16 | 2.18 | 1.12 |
| Pelargonidin | Anthocyanins | 2.68 | 69814.81 | 16.09 | 2.70 | 217037.04 | 17.73 | 1.40 | 3.11 | 1.64 |
| Formononetin (4'-O-methyldaidzein) | Isoflavone | - | - | - | 2.17 | 2970.37 | 11.54 | 2.90 | 18.15 | 4.18 |
| Orobol (5,7,3',4'-tetrahydroxyisoflavone) | Isoflavone | 1.10 | 0.15 | -2.71 | - | - | - | - | - | - |
| Genistein (4',5,7-Trihydroxyisoflavone) | Isoflavone | 2.47 | 0.00 | -13.75 | 2.37 | 0.00 | -13.75 | - | - | - |
| 7-O-Methyleriodictyol | Flavanone | 1.35 | 0.06 | -4.08 | 1.19 | 0.09 | -3.48 | - | - | - |
| Protocatechuic acid | Polyphenol | - | - | - | - | - | - | 1.19 | 2.27 | 1.19 |
| Ellagic acid | Polyphenol | 2.76 | 143333.33 | 17.13 | 2.73 | 287777.78 | 18.13 | 1.09 | 2.01 | 1.01 |
| Hesperetin | Flavanone | 2.19 | 1788.89 | 10.80 | 2.09 | 1651.85 | 10.69 | - | - | - |
| Pinocembrin (Dihydrochrysin) | Flavanone | - | - | - | 1.05 | 6.47 | 2.69 | 1.36 | 2.94 | 1.55 |
| Isosakuranetin-7-neohesperidoside (Poncirin) | Flavanone | 1.75 | 3.49 | 1.80 | 1.87 | 9.68 | 3.27 | 1.32 | 2.77 | 1.47 |
| 3-Hydroxyflavone | Flavonol | 1.73 | 0.07 | -3.92 | 2.14 | 0.00 | -11.23 | 1.26 | 0.01 | -7.30 |
| Isoliquiritigenin | Flavanone | - | - | - | - | - | - | 1.36 | 0.34 | -1.57 |
| Glycitein | Isoflavone | - | - | - | 1.10 | 7.85 | 2.97 | 1.23 | 2.41 | 1.27 |
| Kaempferol 3-O-galactoside (Trifolin) | Flavonol | 2.77 | 0.00 | -17.20 | 2.66 | 0.00 | -17.20 | - | - | - |
| 2'-Hydroxygenistein | Isoflavone | 1.12 | 0.14 | -2.82 | - | - | - | - | - | - |
| 3,7-Di-O-methylquercetin | Flavonol | 1.08 | 6.19 | 2.63 | - | - | - | - | - | - |
| Kaempferol 3-O-rhamnoside (Kaempferin) | Flavonol | - | - | - | 1.05 | 6.51 | 2.70 | 1.10 | 2.03 | 1.02 |
| Sissotrin | Isoflavone | - | - | - | 1.06 | 0.36 | -1.47 | 1.73 | 0.44 | -1.19 |
| Quercetin 7-O-β-D-Glucuronide | Flavonol | - | - | - | 1.19 | 11.16 | 3.48 | 1.87 | 7.51 | 2.91 |
| Kaempferol-3-O-robinoside-7-O-rhamnoside (Robinin) | Flavonol | 2.60 | 37000.00 | 15.18 | 2.57 | 72777.78 | 16.15 | - | - | - |
| Morin | Flavonol | 1.04 | 0.18 | -2.45 | - | - | - | 1.33 | 2.81 | 1.49 |
| Cyanidin | Anthocyanins | - | - | - | - | - | - | 1.43 | 3.36 | 1.75 |
| 6,8-di-C-glucoside Apigenine | Flavone | 1.08 | 0.16 | -2.62 | - | - | - | - | - | - |
| 3-O-Acetylpinobanksin | Flavonoid | - | - | - | 1.08 | 7.24 | 2.86 | 1.49 | 3.65 | 1.87 |
| Delphin chloride | Anthocyanins | - | - | - | 2.07 | 0.00 | -10.46 | 3.59 | 0.00 | -10.76 |
| Narcissoside | Flavonoid | 1.40 | 21.35 | 4.42 | 1.34 | 20.74 | 4.37 | - | - | - |
| Tiliroside | Flavonoid | - | - | - | - | - | - | 1.14 | 2.12 | 1.08 |
| Orientin | Flavonoid | - | - | - | - | - | - | 1.63 | 4.88 | 2.29 |
| 5,7-Dihydroxychromone | Flavonoid | 2.46 | 12703.70 | 13.63 | 2.47 | 31000.00 | 14.92 | 1.24 | 2.44 | 1.29 |
| Persicoside | Flavonoid | 1.14 | 7.44 | 2.89 | 1.02 | 5.91 | 2.56 | - | - | - |
| Pedalitin | Flavonoid | 1.19 | 0.11 | -3.16 | - | - | - | - | - | - |
| 6-Gingerol | Polyphenol | 2.75 | 0.00 | -17.04 | - | - | - | 4.36 | 59629.63 | 15.86 |
| Apiin | Flavonoid | 1.07 | 6.01 | 2.59 | - | - | - | - | - | - |
| Tectochrysin | Flavonoid | - | - | - | 1.03 | 6.09 | 2.61 | - | - | - |
| Tectorigenin | Flavonoid | - | - | - | - | - | - | 1.27 | 2.61 | 1.39 |

‘-’ indicates no significant difference in the comparison.

**Table S4** Throughput and quality of *L. japonica* transcriptome data

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Samplesa | Raw Reads | Clean Reads | Clean Bases | Raw *Q*30 Bases Rate (%)b | Clean *Q*30 Bases Rate (%) |
| GB\_Pe\_1 | 52,554,608 | 47,372,044 | 7,105,806,600 | 93.74 | 96.71 |
| GB\_Pe\_2 | 49,904,878 | 45,187,308 | 6,778,096,200 | 93.95 | 96.77 |
| GB\_Pe\_3 | 50,123,328 | 45,369,930 | 6,805,489,500 | 93.88 | 96.72 |
| WF\_Pe\_1 | 48,636,608 | 44,364,202 | 6,654,630,300 | 94.17 | 96.78 |
| WF\_Pe\_2 | 50,602,176 | 46,142,190 | 6,921,328,500 | 94.08 | 96.69 |
| WF\_Pe\_3 | 50,327,012 | 46,073,580 | 6,911,037,000 | 94.48 | 96.87 |
| YF\_Pe\_1 | 48,648,046 | 44,428,890 | 6,664,333,500 | 94.3 | 96.81 |
| YF\_Pe\_2 | 48,964,662 | 45,067,580 | 6,760,137,000 | 94.64 | 96.87 |
| YF\_Pe\_3 | 48,804,566 | 44,571,092 | 6,685,663,800 | 94.25 | 96.76 |
| Total/Average | 448,565,884 | 408,576,816 | 61,286,522,400 | 94.17 | 96.78 |

a1, 2 and 3: Three independent biological replicates

b*Q*30: The percentage of bases with a Phred value >30

**Table S5** Summary of *L. japonica* de novo transcriptome assembly

|  |  |  |
| --- | --- | --- |
| Header | Transcripts | Unigenes |
| Total number | 131,409 | 69,946 |
| Total nucleotides | 139,626,750 | 60,901,270 |
| Percent GC (%) | 39.9 | 39.6 |
| Average length (bp) | 1,063 | 871 |
| Minimum length (bp) | 201 | 201 |
| Maximum length (bp) | 14,346 | 14,346 |
| N50a (bp) | 1,713 | 1,636 |
| N90b (bp) | 463 | 317 |

aN50 is defined as the length of the largest contig from all the contigs ranked smallest to largest that represents 50 % of the assembly lengthy.

bN90 is defined as the length of the smallest transcript in the sorted list of all transcripts where the cumulative length from the largest transcript to the smallest transcript is at least 90 % of the total length.

**Table S6** Mapping results of *L. japonica* unigenes to various databases

|  |  |  |  |
| --- | --- | --- | --- |
| Database | Count | Percentage | |
| BLASTP | 17733 | 25.35 | |
| BLASTX | 23756 | 33.96 | |
| GO | 22662 | 32.4 | |
| KO | 9309 | 13.31 | |
| NR | 31468 | 44.99 | |
| NT | 16799 | 24.02 | |
| PFAM | 18260 | 26.11 | |
| Prot | 23459 | 33.54 | |
| SignalP | 1646 | 2.35 | |
| TmHMM | 5367 | 7.67 | |
| eggNOG | 11867 | 16.97 | |
| Total\_anno | 34068 | 48.71 | |
| Total\_unigene | 69946 | 100 |

aN50 is defined as the length of the largest contig from all the contigs ranked smallest to largest that represents 50 % of the assembly lengthy.

bN90 is defined as the length of the smallest transcript in the sorted list of all transcripts where the cumulative length from the largest transcript to the smallest transcript is at least 90 % of the total length.

**Table S7** Genes involving in plant hormone transduction and pigments metabolism