

Supplementary Information

RNAseq revealed the important gene pathways controlling adaptive mechanisms under waterlogged stress in maize

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Table S1. RNA sequencing yield and mapping results of HKI 1105 roots under non-stress and waterlogging stress conditions.

| Treatment | Number of paired reads | % of mapped reads | Genes RPKM>0 | Genes RPKM>1 | Genes RPKM>2 | Genes RPKM>5 |
|------------|------------------------|-------------------|--------------|--------------|--------------|--------------|
| Non-stress | 4,77,17,398 | 88 | 21364 | 12633 | 9092 | 4381 |
| Stress | 4,49,04,070 | 84.073 | 21364 | 13872 | 10481 | 5396 |

Table S2. Characteristics of single nucleotide polymorphisms (SNPs) mapped in maize roots under non-stress and waterlogging stress conditions.

| Genomic regions | SNPs mapped in non-stress sample | | SNPs mapped in stress sample | |
|----------------------|----------------------------------|----------|------------------------------|----------|
| | Read counts | Rate (%) | Read counts | Rate (%) |
| Downstream | 66,880 | 13.93% | 60,365 | 11.08% |
| Exon | 47,941 | 9.99% | 40,133 | 7.37% |
| Intergenic | 6,106 | 1.27% | 4,309 | 0.79% |
| Intron | 78,945 | 16.45% | 43,845 | 8.05% |
| Splice site acceptor | 42,667 | 8.89% | 62,319 | 11.44% |
| Splice site donor | 51,220 | 10.67% | 87,447 | 16.06% |
| Splice site region | 1,02,022 | 21.26% | 1,66,235 | 30.52% |
| Transcript | 226 | 0.05% | 215 | 0.04% |
| Upstream | 48,503 | 10.11% | 49,902 | 9.16% |
| UTR 3' | 21,827 | 4.55% | 18,751 | 3.44% |
| UTR 5' | 13,662 | 2.85% | 11,167 | 2.05% |
| Total | 4,79,999 | – | 5,44,688 | – |

Table S3A. Amino acid substitutions in SNPs identified in non-stress expressed transcripts. Rows represent amino acids in B73 maize genome while columns represent changed amino acids. Red colour indicates more changes happened and grey colour represents diagonals.

| | * | - | ? | A | C | D | E | F | G | H | I | K | L | M | N | P | Q | R | S | T | V | W | Y |
|---|---------|---------|------------|-----------|---------|-----------|-----------|---------|-----------|---------|-----------|-----------|-----------|---------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---------|---------|
| * | 34 | 5 | | 3 | 5 | 2 | 5 | 20 | 6 | 3 | 1 | 3 | 31 | | | | 37 | 48 | 8 | 3 | 5 | 9 | 14 |
| - | 72 2 | | 15,99 4 | 1,51 3 | 66 9 | 1,45 8 | 1,80 3 | 88 6 | 1,65 2 | 70 3 | 2,07 9 | 2,44 3 | 3,29 2 | 69 9 | 1,67 0 | 957 | 873 | 1,47 4 | 1,77 1 | 1,52 4 | 1,88 1 | 45 9 | 80 5 |
| ? | | | | | | | | | | | | | | | | | | | | | | | |
| A | 3 | 11 8 | | 1,49 6 | 19 | 39 | 205 | 1 | 188 | 20 | 39 | 46 | 62 | 1 | | 140 | 8 | 54 | 695 | 128 | 273 | 41 | 35 |
| C | 53 | 15 | | | 39 5 | 2 | | 11 5 | 1 | | 1 | 26 | 10 | 13 | 26 | | 4 | 111 | 111 | | 25 | 33 | 43 |
| D | 23 | 65 | | 104 | 50 | 865 | 395 | | 377 | 25 | 16 | 4 | 26 | 6 | 110 | 13 | 34 | 25 | 3 | 5 | 155 | | 27 7 |
| E | 60 6 | 20 6 | | 113 | 1 | 510 | 1,80 9 | 2 | 380 | | 3 | 461 | 9 | 0 | 15 | 3 | 79 | 12 | 6 | 21 | 270 | 50 | 3 |
| F | 61 | 91 | | 7 | 22 | 1 | | 20 8 | 18 | 1 | 34 | 5 | 471 | 2 | 6 | 10 | | 7 | 150 | 27 | 158 | 3 | 10 |
| G | 80 | 11 0 | | 189 | 20 9 | 115 | 158 | 1 | 1,79 7 | 14 | 3 | 24 | 19 | 70 | 15 | 1 | | 92 | 61 | 22 | 768 | 12 3 | 57 |
| H | 1 | 11 | | 62 | | 13 | 2 | 1 | | 21 4 | | 4 | 47 | | 32 | 12 | 133 | 87 | 4 | | 1 | 2 | 18 1 |
| I | 14 | 99 | | 31 | 1 | 52 | 3 | 37 | 26 | 2 | 723 | 59 | 117 | 93 | 116 | 4 | 68 | 96 | 132 | 319 | 367 | 18 | 11 |
| K | 99 | 39 1 | | | | 1 | 460 | | 2 | | 63 | 1,42 8 | 14 | 57 | 405 | 6 | 82 | 345 | 89 | 36 | | 2 | 58 |
| L | 77 | 14 1 | | 10 | 16 0 | 2 | 24 | 41 7 | 18 | 22 5 | 238 | 27 | 1,64 0 | 35 | 16 | 542 | 97 | 31 | 527 | 18 | 95 | 72 | 63 |
| M | | 50 | | 1 | | 5 | | 2 | 6 | 9 | 200 | 63 | 34 | 28 3 | 71 | 1 | 1 | 12 | 23 | 92 | 49 | 4 | 65 |
| N | 12 | 62 | | | | 204 | 3 | | 2 | 45 | 209 | 312 | 1 | 57 | 607 | 2 | 9 | 6 | 173 | 108 | | | 19 |
| P | | 65 | | 121 | 4 | | | | | 56 | | 10 | 224 | | 2 | 1,04 4 | 70 | 33 | 205 | 158 | 12 | | |
| Q | 30 5 | 75 | | 6 | | 24 | 19 | 5 | 8 | 29 8 | 9 | 33 | 108 | 3 | 7 | 55 | 2,23 8 | 169 | 18 | 6 | 5 | 2 | 1 |
| R | 37 | 10 2 | | 9 | 32 | 1 | 40 | | 154 | 59 | 29 | 61 | 210 | 14 4 | 6 | 36 | 21 | 1,62 2 | 449 | 44 | 9 | 49 | 5 |

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---------|---------|--|-----|---------|-----|-----|---------|-----|---------|-----|-----|-----|---------|-----|-----|----|-----|-----------|-----|-----------|----|---------|
| S | 13 9 | 25 9 | | 30 | 16 9 | 3 | 6 | 20 3 | 258 | 4 | 295 | 48 | 341 | 2 | 46 | 276 | 3 | 161 | 2,12 0 | 342 | 6 | 1 | 7 |
| T | | 33 | | 583 | 7 | | 69 | | 6 | 7 | 497 | 69 | 11 | 32 | 108 | 40 | | 71 | 27 | 847 | 3 | | 1 |
| V | 21 | 24 9 | | 632 | 33 | 132 | 196 | 13 0 | 255 | 68 | 248 | 108 | 381 | 11 3 | 71 | 9 | 63 | 293 | 136 | 33 | 1,53 9 | 16 | 9 |
| W | 67 | 7 | | | 68 | 69 | | 2 | 10 | 1 | | 3 | 49 | | | | | 148 | 1 | | | 46 | |
| Y | 71 | 69 | | 14 | 98 | 40 | 6 | 39 | 12 | 11 4 | 70 | 2 | 59 | 1 | 60 | | 18 | 9 | 31 | 14 | 10 | 7 | 19 4 |

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Table S3B. Amino acid substitutions in SNPs identified in stress expressed transcripts. Rows represent amino acids in B73 maize genome while columns represent changed amino acids. Red colour indicates more changes happened and grey colour represents diagonals.

| | * | - | ? | A | C | D | E | F | G | H | I | K | L | M | N | P | Q | R | S | T | V | W | Y |
|---|-----------|---------|------------|-----------|-----------|-----------|-----------|-----------|-----------|---------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---------|-----------|
| * | 105 | 22 | 1 | 8 | 21 | 3 | 1 | 33 | 5 | | 1 | | 15 | | | | | 3 | 53 | 6 | 12 | 30 | 42 |
| - | 1,3 77 | | 25,1 01 | 2,8 04 | 1,7 14 | 1,9 79 | 3,2 55 | 1,9 74 | 3,2 89 | 99 6 | 2,8 96 | 3,7 84 | 5,5 97 | 1,3 28 | 2,1 02 | 1,7 82 | 2,3 08 | 3,8 61 | 3,4 53 | 2,8 99 | 2,8 86 | 76 5 | 1,47 9 |
| ? | | | | | | | | | | | | | | | | | | | | | | | |
| A | 36 | 79 | | 1,2 29 | 13 | 97 | 112 | 16 | 323 | 56 | 44 | 137 | 69 | 10 | 21 | 119 | 48 | 117 | 140 | 101 | 130 | 42 | 30 |
| C | 33 | 34 | | 7 | 332 | | | 21 | 5 | | | 13 | 36 | 14 | 25 | 6 | | 111 | 23 | | 11 | 26 | 29 |
| D | 75 | 73 | | 48 | 3 | 944 | 323 | 19 | 67 | 10 4 | 30 | 25 | 55 | 8 | 81 | 14 | 36 | 64 | 21 | 26 | 79 | | 115 |
| E | 162 | 19 1 | | 158 | 18 | 256 | 2,9 25 | 11 | 197 | | 32 | 65 | 28 | 21 | 140 | 9 | 124 | 59 | 61 | 21 | 241 | 75 | 82 |
| F | 3 | 34 | | 1 | 146 | 9 | 5 | 211 | 27 | | 26 | 1 | 203 | 9 | 17 | 4 | | 11 | 196 | 74 | 57 | 12 | 60 |
| G | 68 | 13 4 | | 190 | 36 | 115 | 227 | 3 | 1,7 45 | 14 | 7 | 75 | 47 | 44 | 19 | 4 | 20 | 141 | 85 | 8 | 295 | 98 | 12 |
| H | 1 | 7 | | 37 | | 6 | 5 | 1 | | 20 4 | | 1 | 8 | | | 5 | 85 | 42 | 14 | 1 | | 1 | 29 |
| I | 45 | 49 | | 58 | | 57 | 63 | 4 | 26 | 18 | 549 | 99 | 77 | 82 | 44 | 104 | 92 | 98 | 20 | 159 | 131 | 3 | 174 |
| K | 23 | 12 8 | | | 2 | 39 | 201 | 13 | 4 | 27 | 33 | 3,0 21 | 27 | 15 | 499 | 11 | 41 | 123 | 48 | 19 | 14 | 3 | 20 |
| L | 21 | 87 | | 7 | 159 | 7 | 27 | 211 | 14 | 44 | 99 | 54 | 2,1 36 | 14 | | 137 | 41 | 33 | 272 | 56 | 58 | 18 | 48 |
| M | 22 | 78 | | | 1 | | | | 3 | 10 | 358 | 60 | 24 | 397 | 5 | 2 | 14 | 127 | 120 | 281 | 14 | | 63 |
| N | 16 | 50 | | 12 | | 39 | | | 12 | 3 | 158 | 233 | 17 | 37 | 334 | 1 | 1 | 24 | 61 | 22 | 4 | 2 | 65 |
| P | 7 | 34 | | 70 | 18 | 6 | | | 4 | 15 9 | 3 | 4 | 193 | | 105 | 753 | 130 | 15 | 45 | 27 | 8 | | 1 |
| Q | 11 | 11 1 | | 8 | 10 | 18 | 38 | 9 | 10 | 25 1 | 13 | 23 | 156 | | | 84 | 3,0 71 | 29 | 34 | 95 | 5 | | 3 |
| R | 16 | 12 | | 11 | 108 | 8 | 35 | 9 | 121 | 31 | 25 | 135 | 55 | 18 | 13 | 18 | 13 | 1,6 | 249 | 38 | | 4 | 2 |

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|-----|---------|--|-----|-----|-----|-----|-----|-----|----|-----|-----|-----|-----|-----|-----|----|-----|-----------|-----------|-----------|---------|-----|
| | | 3 | | | | | | | | | | | | | | | 10 | | | | | | |
| S | 100 | 13 3 | | 27 | 110 | 78 | 12 | 135 | 39 | 12 | 105 | 127 | 62 | 56 | 55 | 104 | 5 | 175 | 2,3 63 | 82 | 13 | 15 | 28 |
| T | 3 | 62 | | 265 | | 24 | 69 | 3 | 80 | 31 | 160 | 50 | 27 | 73 | 41 | 5 | 2 | 18 | 12 | 1,0 75 | 3 | 2 | 12 |
| V | 89 | 16 0 | | 418 | 91 | 222 | 220 | 67 | 249 | 54 | 147 | 289 | 276 | 152 | 171 | 37 | 93 | 157 | 183 | 46 | 1,6 98 | 22 | 17 |
| W | 131 | 7 | | 6 | 198 | | | 5 | 3 | 3 | 1 | 2 | 23 | 2 | 1 | | | 18 | 2 | | 13 | 12 0 | 4 |
| Y | 69 | 46 | | 18 | 75 | 28 | 2 | 27 | 11 | 83 | 40 | 4 | 401 | 1 | 17 | 1 | 12 | 65 | 33 | 14 | 35 | 8 | 226 |

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Table S4. Maize gene expression of Energy-Production Pathway related genes.

| Gene name | Gene ID | Annotation | Root (Fold change) |
|------------------------------|-----------------|--|--------------------|
| Lactate dehydrogenase (LDH) | GRMZM2G128929 | L-lactate dehydrogenase | -3.212497736 |
| | GRMZM2G136072 | Glyoxylate reductase | 1.173986375 |
| | GRMZM2G074282 | hydroxypyruvate reductase | -1.559328686 |
| | GRMZM2G159587 | Glyoxylate reductase | -4.088633483 |
| | GRMZM2G049811 | Uncharacterized protein | 1.290277478 |
| Alcohol dehydrogenase (ADH) | GRMZM2G442658 | Alcohol dehydrogenase 1 | 1.432565675 |
| | GRMZM2G152981 | Uncharacterized protein | 7.581995337 |
| | GRMZM2G149272 | GroES-like zinc-binding dehydrogenase family protein | 1.335785779 |
| | GRMZM2G139512 | Putative alcohol dehydrogenase superfamily protein | -1.600840623 |
| | GRMZM2G154007 | Uncharacterized protein | 1.625654786 |
| | GRMZM2G008728 | Uncharacterized protein | -1.195732434 |
| | GRMZM2G024303 | Uncharacterized protein | 2.388562704 |
| | AC197705.4_FG00 | | |
| Pyruvate decarboxylase (PDC) | 1 | Pyruvate decarboxylase isozyme 1 | 3.729852545 |
| | GRMZM2G038821 | Pyruvate decarboxylase isozyme 2 | -1.721529887 |
| | GRMZM2G087186 | Pyruvate decarboxylase isozyme 3 | 1.140414241 |
| Sucrose synthase (SUS) | GRMZM2G152908 | Sucrose synthase 2 | 7.341513957 |
| | GRMZM2G055331 | Putative sucrose-phosphate synthase family protein isoform 1 | 1.97603525 |
| | GRMZM2G008507 | Putative sucrose-phosphate synthase family protein | 2.568095195 |
| | GRMZM2G318780 | Sucrose synthase | 2.054476156 |
| | GRMZM2G140107 | unknown | -1.923416289 |
| | GRMZM2G462613 | unknown | 1.411547519 |
| | GRMZM2G318780 | Sucrose synthase | 2.054476156 |
| Invertase (INV) | GRMZM2G119689 | Beta-fructofuranosidase, insoluble isoenzyme 2 | 48.59578188 |
| | GRMZM2G084940 | unknown | 1.759401624 |

| | | | |
|---------------------------|------------------|--|--------------|
| | GRMZM2G040843 | alkaline/neutral invertase | -1.135731523 |
| | GRMZM2G136139 | Neutral/alkaline invertase | -18.17170437 |
| | GRMZM2G139300 | Beta-fructofuranosidase, cell wall isozyme | -1.982367749 |
| | AC213432.2_FG004 | Uncharacterized protein | -4.008464199 |
| | GRMZM2G022782 | Uncharacterized protein | 1.042685267 |
| | GRMZM2G118737 | Uncharacterized protein | 1.184594685 |
| | GRMZM2G175499 | Pectinesterase | 3.057256184 |
| | GRMZM2G136106 | Pectinesterase | 15.40857117 |
| | GRMZM2G007277 | Uncharacterized protein | -1.032483203 |
| | GRMZM2G115451 | Uncharacterized protein | 19.07727859 |
| | GRMZM2G170842 | Uncharacterized protein | 3.0980196 |
| | GRMZM2G084694 | unknown | -1.168180995 |
| | GRMZM2G089836 | Invertase | 19.81102007 |
| Hexokinase | GRMZM2G104081 | Uncharacterized protein | 3.06837348 |
| | GRMZM2G046686 | Hexokinase-1 | 35.58646199 |
| | GRMZM2G051806 | Hexokinase-1 | 2.262369576 |
| | GRMZM2G467069 | Uncharacterized protein | 2.31315112 |
| | GRMZM2G432801 | Hexokinase-2 | 1.486296853 |
| | GRMZM2G058745 | Uncharacterized protein | 1.514821129 |
| | GRMZM2G171373 | Uncharacterized protein | 12.84047597 |
| Phosphoglucose isomerase | GRMZM2G065083 | unknown | 1.265869317 |
| | GRMZM2G140614 | Glucose-6-phosphate isomerase | 2.082124386 |
| Phosphofructokinase (PFK) | GRMZM5G879882 | Uncharacterized protein | 7.283063621 |
| | GRMZM2G127717 | unknown | 2.377322409 |
| | GRMZM2G059151 | Uncharacterized protein | 2.308584577 |
| | GRMZM2G443985 | Uncharacterized protein | 1.434131083 |
| | GRMZM2G132069 | Uncharacterized protein | -1.362877828 |
| | GRMZM2G004932 | Uncharacterized protein | 2.729003415 |
| | GRMZM2G139360 | Uncharacterized protein | 2.292942138 |

| | | | |
|--|---------------|--|--------------|
| | GRMZM2G324471 | Uncharacterized protein | -1.068496217 |
| Fructose-6-bisphosphate aldolase (ALD) | GRMZM2G057823 | Fructose-bisphosphate aldolase | 1.612832182 |
| | GRMZM2G066024 | Fructose-bisphosphate aldolase | 1.022441779 |
| | GRMZM2G089365 | Fructose-bisphosphate aldolase | -1.460226244 |
| | GRMZM2G069195 | Fructose-bisphosphate aldolase | -1.060016088 |
| Triose phosphate isomerase (TPI) | GRMZM2G030784 | Triosephosphate isomerase | 1.231336284 |
| Glyceraldehyde-3-phosphate dehydrogenase (GAPDH) | GRMZM2G051004 | Glyceraldehyde-3-phosphate dehydrogenase | 3.293304801 |
| | GRMZM2G104632 | Glyceraldehyde-3-phosphate dehydrogenase | 2.650101596 |
| | GRMZM2G176307 | Uncharacterized protein | 2.159525483 |
| Phosphoglycerate kinase (PGK) | GRMZM2G003724 | Phosphoglycerate kinase | 8.804897811 |
| | GRMZM2G382914 | Phosphoglycerate kinase | 2.107393457 |
| | GRMZM2G047028 | Phosphoglycerate kinase | 1.85881176 |
| | GRMZM2G089136 | Phosphoglycerate kinase | 2.934965937 |
| 3-Phosphoglycerate dehydrogenase (PHGDH) | GRMZM2G073814 | Uncharacterized protein | 1.65091834 |
| | GRMZM2G009323 | Uncharacterized protein | 2.65981288 |
| | GRMZM2G073814 | Uncharacterized protein | 1.65091834 |
| Enolase (ENO) | GRMZM2G034848 | Enolase | 1.729533499 |
| | GRMZM2G481529 | unknown | -1.20253926 |

Table S5. Maize gene expression of Programmed Cell Death related genes.

| Gene name | Gene ID | Annotation | Root (Fold change) | |
|--|-------------------------------------|--|-----------------------------------|--------------|
| Bifunctional nuclease 1 (BFN1) | GRMZM2G112968 | Putative bifunctional nuclease | 3.249426573 | |
| Metallothionein (MT) | GRMZM2G099340 | metallothionein-like protein type 2 | 1.247360523 | |
| | GRMZM2G402564 | Metallothionein2 | -5.45151131 | |
| | GRMZM2G430807 | metallothionein-like protein type 2 | -6.814389138 | |
| | | | | |
| Mitogen-activated Protein Kinase (MAPK) | GRMZM2G007848 | Putative uncharacterized protein | 1.790329222 | |
| | GRMZM2G007854 | hypothetical protein LOC100192548 | -1.202887822 | |
| | GRMZM2G025242 | MAPK activating protein Putative uncharacterized protein | 1.392441226 | |
| | GRMZM2G048455 | Putative uncharacterized protein | 1.164203155 | |
| | GRMZM2G062914 | MPK14-putative uncharacterized protein | -1.186950788 | |
| | GRMZM2G089484 | product :mitogen activated protein kinase 6 | 1.802451907 | |
| | GRMZM2G102088 | Putative uncharacterized protein | 1.028642368 | |
| | GRMZM2G104283 | Putative uncharacterized protein | -1.29671871 | |
| | GRMZM2G122335 | hypothetical protein LOC100279919 | 3.271765307 | |
| | GRMZM2G135904 | MAP kinase activity | 2.112286091 | |
| | GRMZM2G306028 | hypothetical protein LOC100277192 | 1.199385119 | |
| | Plant aspartic protease A3 (PASPA3) | GRMZM2G036134 | hypothetical protein LOC100191400 | 18.71040785 |
| | | GRMZM2G065757 | aspartic proteinase oryzasin-1 | -1.147203559 |
| GRMZM2G128922 | | Aspartic proteinase nepenthesin-1 | 1.100612226 | |
| GRMZM2G153523 | | Hypothetical protein LOC100279644 | 1.141375642 | |
| GRMZM2G177575 | | Aspartic-type endopeptidase/ pepsin A | 2.134520682 | |
| GRMZM2G339736 | | transcription factor activity | 3.852142792 | |
| Respiratory Burst Oxidase Homolog (RBOH) | GRMZM2G022547 | fae2 protein | 1.951894822 | |
| | GRMZM2G034896 | hypothetical protein LOC100384248 | 12.16466145 | |
| | GRMZM2G043435 | product:respiratory burst oxidase-like protein C | 1.274008846 | |

| | | |
|---------------|---|--------------|
| GRMZM2G138152 | respiratory burst oxidase protein B | -1.086739183 |
| GRMZM2G300965 | hypothetical protein LOC100381459 | 1.004067294 |
| GRMZM2G441541 | oxidoreductase activity, acting on NADH or NADPH, with oxygen as acceptor | -1.214738933 |
| GRMZM2G441541 | oxidoreductase activity, acting on NADH or NADPH, with oxygen as acceptor | 6.114512369 |
| GRMZM2G448185 | oxidoreductase activity, acting on NADH or NADPH, with oxygen as acceptor | 4.12292834 |

Table S6. Maize gene expression of aerenchyma formation related genes.

| Gene name | Gene ID | Annotation | Root (Fold change) |
|---------------|-----------------|--|--------------------|
| Expansins | GRMZM2G004955 | transcription factor activity | 6.9705441 |
| | GRMZM2G013002 | product:beta-expansin 8 | 8.909718023 |
| | GRMZM2G021621 | Beta-expansin 1a Putative uncharacterized protein | -1.299651537 |
| | GRMZM2G026147 | Expansin-like 3 Putative uncharacterized protein | 2.568095195 |
| | GRMZM2G026956 | hypothetical protein LOC100216633 | -1.362877828 |
| | GRMZM2G056236 | hypothetical protein LOC100273516 | 2.934965937 |
| | GRMZM2G072121 | hypothetical protein LOC100191303 | -1.344208268 |
| | GRMZM2G094523 | Putative uncharacterized protein | 41.8232646 |
| | GRMZM2G095968 | expansin-like 3 (LOC100285844), mRNA | -1.115081859 |
| | GRMZM2G103672 | beta-expansin 4 | 3.668707421 |
| | GRMZM2G105844 | alpha expansin2 | 2.218694488 |
| | GRMZM2G114322 | TSA: Zea mays contig17568, mRNA sequence | 15.40857117 |
| | GRMZM2G120724 | Alpha-expansin 13 Putative uncharacterized protein | 1.696777182 |
| | GRMZM2G127072 | Putative uncharacterized protein | 2.641469343 |
| | GRMZM2G169967 | beta-expansin 3 | 13.73144778 |
| | GRMZM2G176595 | product:beta-expansin 6 | 1.467482969 |
| | GRMZM2G177391 | beta-expansin 1a | 7.704285585 |
| | GRMZM2G342246 | product:beta-expansin 7 | 20.06782959 |
| | GRMZM2G361064 | alpha-expansin 5 | 5.13619039 |
| | GRMZM2G445169 | alpha-expansin 6 | 1.11472264 |
| GRMZM2G474194 | Beta-expansin 3 | 4.151432082 | |
| GRMZM5G859316 | Beta-expansin 4 | 3.668707421 | |
| Pectin lyases | GRMZM2G005562 | Pectate lyase 4 | -1.369187447 |
| | GRMZM2G131912 | pectate lyase 8 | -1.166173811 |
| | GRMZM2G412207 | Hypothetical protein LOC100273705 | 1.170020205 |
| | GRMZM2G472060 | pectate lyase 12 | -1.544594871 |

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| | | | |
|---------------------------------|------------------|--|--------------|
| Polygalacturonases | AC231180.2_FG006 | Uncharacterized protein | 11.73986375 |
| | GRMZM2G026855 | hypothetical protein LOC100273291 | -2.756730151 |
| | GRMZM2G037431 | polygalacturonase | 8.337971412 |
| | GRMZM2G052844 | 6-phosphofructokinase complex | 1.687605414 |
| | GRMZM2G057296 | hypothetical protein LOC100272593 | 1.85881176 |
| | GRMZM2G079617 | polygalacturonase (LOC100285007), mRNA | 1.467482969 |
| | GRMZM2G092746 | Rho guanyl-nucleotide exchange factor activity | 2.201224453 |
| | GRMZM2G113815 | polygalacturonase (LOC100282607), mRNA | 1.875117126 |
| | GRMZM2G119494 | Glycoside hydrolase, family 28 Putative uncharacterized protein | -2.504149504 |
| | GRMZM2G130401 | Transcribed locus | 1.956643958 |
| | GRMZM2G135763 | hypothetical protein LOC100273073 | 1.226552929 |
| | GRMZM2G137077 | polygalacturonase (LOC100282589), mRNA | -1.045929496 |
| | GRMZM2G139828 | hypothetical protein LOC100191454 | 2.568095195 |
| | GRMZM2G174598 | Putative uncharacterized protein | 5.503061132 |
| | GRMZM2G179696 | Putative uncharacterized protein | 2.297452844 |
| | GRMZM2G348602 | Clone 1560552 mRNA sequence | 1.04820212 |
| | GRMZM2G467435 | hypothetical protein LOC100194076 | 16.14231265 |
| | GRMZM5G831200 | hypothetical protein LOC100194130 | 5.869931874 |
| | GRMZM5G882418 | polygalacturonase (LOC100285112), mRNA | 5.936635645 |
| Xyloglucan transglycosylases | GRMZM2G039919 | hypothetical protein LOC100382994 (LOC100382994), mRNA | 5.869931874 |
| | GRMZM2G060837 | Putative uncharacterized protein | 10.76154177 |
| | GRMZM2G112198 | hypothetical protein | 3.668707421 |
| | GRMZM2G128876 | Xyloglucan endotransglycosylase/hydrolase protein 8 | -2.101103317 |
| | GRMZM2G180870 | Glycosyl hydrolases family 16 protein | -1.070832579 |
| | GRMZM2G319798 | hydrolase activity, hydrolyzing O-glycosyl compounds | 7.337414843 |
| | GRMZM2G364748 | Putative uncharacterized protein Xyloglucan endotransglycosylase/hydrolase protein 8 ; | -1.382347511 |
| | GRMZM2G392125 | xyloglucan endotransglucosylase/hydrolase protein 15 | -1.930743589 |

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| GRMZM2G413006 | Xyloglucan endotransglucosylase/hydrolase protein 23 | 1.834353711 |
| GRMZM2G413044 | Xyloglucan endotransglucosylase/hydrolase protein 32 | -1.533237556 |

Table S7. Maize gene expression of ethylene-responsive pathway related genes.

| Gene name | Gene ID | Annotation | Root (Fold change) | |
|--------------------|--------------------------------------|--|--|-------------|
| ACC synthase (ACS) | AC197672.3_F G002 | Acetyl-CoA carboxylase Fragment | 2.662150513 | |
| | GRMZM2G37 7341 | Putative uncharacterized protein | 1.243284182 | |
| ERF VII | GRMZM2G01 8398 | Ethylene response element binding protein Putative uncharacterized protein | 2.827321228 | |
| | GRMZM2G05 2667 | vacuolar protein-sorting protein 45 | -2.903522328 | |
| | GRMZM2G05 3503 | ethylene-responsive factor-like protein 1 | -6.673401776 | |
| | GRMZM2G08 5964 | Ethylene responsive element binding protein 2 | -2.84426677 | |
| | GRMZM2G11 0333 | ethylene response element binding protein (LOC100283876), mRNA | 1.273505335 | |
| | GRMZM2G14 8333 | Ethylene response factor Putative uncharacterized protein | -3.196873916 | |
| | GRMZM2G16 9382 | ethylene-responsive factor-like protein 1 | -2.141665158 | |
| | GRMZM2G17 1179 | Putative uncharacterized protein | 1.311840836 | |
| | Methionine aminopeptidase (MetAP) | GRMZM2G00 2879 | Methionine aminopeptidase (EC 3.4.11.18) | 1.135791613 |
| | | GRMZM2G06 8982 | Methionine aminopeptidase (EC 3.4.11.18) | 3.48527205 |
| GRMZM2G10 1438 | | hypothetical protein LOC100280388 | -1.125855597 | |
| GRMZM2G11 3062 | | hypothetical protein LOC100274208 | 1.546225957 | |
| GRMZM2G13 | | Hypothetical protein LOC100191629 | 1.540857117 | |

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|---|---------------|--|--------------|
| | 1473 | | |
| | GRMZM5G83 | | |
| | 7364 | methionine aminopeptidase 1A | -1.116399923 |
| Arginyl-tRNA--protein transferase (ATE) | GRMZM2G160556 | hypothetical protein LOC100383012 | 1.074671871 |
| E3 ubiquitin ligases_SKP1 | GRMZM2G029307 | hypothetical protein LOC100273625 | 1.956643958 |
| | GRMZM2G032562 | SKP1-like protein 1B | 5.319625761 |
| | GRMZM2G052241 | LOC100274693 | 1.467482969 |
| | GRMZM2G074282 | Putative uncharacterized protein | -1.559328686 |
| | GRMZM2G101446 | SKP1-like protein 1A | -1.268793559 |
| | GRMZM2G109725 | Putative uncharacterized protein | 1.634242397 |
| | GRMZM2G142825 | Putative uncharacterized protein | 1.971031046 |
| E3 ubiquitin ligases_RBX1 | GRMZM2G035341 | RING-box protein 1a | 1.117876732 |
| | GRMZM2G057150 | hypothetical protein LOC100383383 | -1.135731523 |
| | GRMZM2G361074 | Putative uncharacterized protein RING-box protein 1a | 1.100612226 |
| E3 ubiquitin ligases_Cullin related | GRMZM2G027750 | cullin-RING ubiquitin ligase complex | 1.150640055 |
| | GRMZM2G126253 | cullin-RING ubiquitin ligase complex | 2.405899709 |
| | GRMZM2G166089 | cullin-RING ubiquitin ligase complex | 1.23483323 |
| | GRMZM2G166694 | cullin-RING ubiquitin ligase complex | 1.199828842 |

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|-------------------------------------|----------------------|---|--------------|
| E3 ubiquitin ligases_RING Finger | GRMZM2G16 8886 | cullin-RING ubiquitin ligase complex | 1.735924975 |
| | GRMZM2G38 0184 | Putative uncharacterized protein | 1.634967438 |
| | AC177897.2_F G002 | hypothetical protein LOC100274874 | 20.17789082 |
| | AC191534.3_F G003 | Transcribed locus, moderately similar to NP_001170535.1 hypothetical protein LOC100384551 [Zea mays] | 2.130217212 |
| | AC197705.4_F G006 | LOC100274105 | 1.095136544 |
| | AC210013.4_F G009 | RING/U-box superfamily protein | 1.173986375 |
| | AC211190.4_F G004 | unknown protein | 1.100612226 |
| | AC212353.4_F G004 | hypothetical protein LOC100304207 | 1.91901619 |
| | AC213654.3_F G001 | hypothetical protein LOC100194242 | 1.351158099 |
| | AC225564.3_F G003 | cysteine-type endopeptidase activity | -1.817170437 |
| | AC231747.1_F G001 | hypothetical protein LOC100217064 | 1.028974744 |
| | AC233939.1_F G003 | Nitric oxide synthase interacting protein Putative uncharacterized protein | -1.362877828 |
| | GRMZM2G00 0014 | hypothetical protein LOC100274308 | 1.008894541 |
| | GRMZM2G00 0114 | Protein binding protein Putative uncharacterized protein | 1.409277514 |
| | GRMZM2G00 1024 | hypothetical protein LOC100191719 | -1.072130558 |
| | GRMZM2G00 1114 | hypothetical protein LOC100191467 | 1.867705596 |
| | GRMZM2G00 | hypothetical protein LOC100191204 | 12.96276622 |

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|-----------|---|--------------|
| 2280 | | |
| GRMZM2G00 | | |
| 3656 | Putative uncharacterized protein RING finger protein 13 | 1.517614374 |
| GRMZM2G00 | | |
| 3725 | hypothetical protein LOC100192054 (LOC100192054), mRNA | 1.559200654 |
| GRMZM2G00 | | |
| 4023 | hypothetical protein LOC100193216 | 1.032357205 |
| GRMZM2G00 | | |
| 4422 | hypothetical protein LOC100274167 | -1.606248868 |
| GRMZM2G00 | | |
| 5365 | Ubiquitin ligase protein FANCL | 2.843248252 |
| GRMZM2G00 | | |
| 5840 | RING-H2 finger protein | 2.201224453 |
| GRMZM2G00 | Transcribed locus, moderately similar to XP_002459697.1 hypothetical protein | |
| 6399 | SORBIDRAFT_02g009010 [Sorghum bicolor] | 8.438027069 |
| GRMZM2G00 | | |
| 6428 | Putative uncharacterized protein | 3.335188565 |
| GRMZM2G00 | | |
| 7288 | hypothetical protein LOC100276421 | 1.907727859 |
| GRMZM2G00 | | |
| 9265 | Putative uncharacterized protein Ubiquitin ligase SINAT5 | 2.171874793 |
| GRMZM2G01 | | |
| 1473 | hypothetical protein LOC100216604 | -1.022158371 |
| GRMZM2G01 | | |
| 3892 | Putative uncharacterized protein Ubiquitin-protein ligase/ zinc ion binding protein | -1.228509591 |
| GRMZM2G01 | | |
| 3971 | ubiquitin ligase complex | 2.170651891 |
| GRMZM2G01 | | |
| 5409 | Putative uncharacterized protein RING-H2 finger protein ATL5F | -1.734571781 |
| GRMZM2G01 | | |
| 7636 | hypothetical protein LOC100279788 | -4.088633483 |
| GRMZM2G01 | | |
| 8070 | RING-H2 finger protein | -1.029111829 |

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|-----------|------|--|--------------|
| GRMZM2G01 | 8798 | TSA: Zea mays contig21068, mRNA sequence | -1.008529592 |
| GRMZM2G01 | 9971 | DNA binding protein Putative uncharacterized protein | 1.467482969 |
| GRMZM2G02 | 0574 | Putative uncharacterized protein | 1.015949747 |
| GRMZM2G02 | 0814 | hypothetical protein LOC100384141 | -1.479439747 |
| GRMZM2G02 | 0996 | hypothetical protein LOC100191809 | 1.239770094 |
| GRMZM2G02 | 1233 | Clone 701858 mRNA sequence | 2.016008156 |
| GRMZM2G02 | 1498 | Putative uncharacterized protein | 4.140398375 |
| GRMZM2G02 | 1879 | hypothetical protein LOC100192713 | 1.834353711 |
| GRMZM2G02 | 2175 | hypothetical protein LOC100192058 | -1.522175236 |
| GRMZM2G02 | 2711 | C3H2C3 RING-finger protein | 1.06895333 |
| GRMZM2G02 | 4690 | hypothetical protein LOC100280299 | -1.24389643 |
| GRMZM2G02 | 5231 | cellulose synthase7 | 3.384788805 |
| GRMZM2G02 | 7120 | protein binding protein (LOC100283571), mRNA | -44.29352939 |
| GRMZM2G02 | 7131 | RING finger protein 5 | -1.18942065 |
| GRMZM2G02 | 7495 | hypothetical protein LOC100280311 | -2.973551624 |
| GRMZM2G02 | 7723 | cellulose synthase-2 | 2.240532032 |
| GRMZM2G02 | | hypothetical protein LOC100304258 | 2.034465025 |

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| 7856 | | |
| GRMZM2G02 | | |
| 8183 | hypothetical protein LOC100217233 | -1.274235367 |
| GRMZM2G02 | | |
| 8353 | hypothetical protein LOC100280232 | 4.971364404 |
| GRMZM2G02 | | |
| 9001 | hypothetical protein LOC100276679 | 1.680779912 |
| GRMZM2G03 | | |
| 0768 | hypothetical protein LOC100383801 | 5.018791752 |
| GRMZM2G03 | | |
| 0955 | RING zinc finger protein-like | 1.773208587 |
| GRMZM2G03 | | |
| 2071 | hypothetical protein LOC100191907 | 1.485057615 |
| GRMZM2G03 | | |
| 2821 | hypothetical protein LOC100278355 | 1.467482969 |
| GRMZM2G03 | | |
| 5601 | zinc finger, C3HC4 type family protein (LOC100281133), mRNA | 1.504791858 |
| GRMZM2G03 | | |
| 5785 | Protein binding protein Putative uncharacterized protein | -1.802515836 |
| GRMZM2G03 | | |
| 5821 | hypothetical protein LOC100279034 | -3.407194569 |
| GRMZM2G03 | | |
| 5899 | hypothetical protein LOC100276255 | 3.06147309 |
| GRMZM2G03 | | |
| 6697 | hypothetical protein LOC100381407 | -1.170923204 |
| GRMZM2G03 | | |
| 7627 | RING-H2 finger protein ATL5F | 10.63925152 |
| GRMZM2G03 | | |
| 9725 | S-ribonuclease binding protein SBP1 | -3.407194569 |
| GRMZM2G04 | | |
| 0207 | Zinc finger, C3HC4 type family protein | 1.704420323 |
| GRMZM2G04 | | |
| 0803 | ring domain containing protein | -1.053132867 |

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|-----------|---|--|--------------|
| GRMZM2G04 | | | |
| 1549 | Putative uncharacterized protein Zinc finger, C3HC4 type family protein | | -2.271463046 |
| GRMZM2G04 | | | |
| 1561 | BRCA1-associated protein | | 1.54338726 |
| GRMZM2G04 | | | |
| 5084 | Putative RING zinc finger domain superfamily protein | | -2.95290196 |
| GRMZM2G04 | | | |
| 5286 | hypothetical protein LOC100194366 | | -1.953458219 |
| GRMZM2G04 | | | |
| 6658 | hypothetical protein LOC100193782 | | 1.144813521 |
| GRMZM2G04 | | | |
| 7167 | zinc ribbon 1 | | 1.56318838 |
| GRMZM2G04 | | | |
| 9070 | hypothetical protein LOC100193225 | | -1.362877828 |
| GRMZM2G04 | | | |
| 9346 | hypothetical protein LOC100191632 | | 1.388159565 |
| GRMZM2G04 | | | |
| 9672 | Putative uncharacterized protein | | 2.132003558 |
| GRMZM2G05 | | | |
| 0216 | zinc finger, C3HC4 type family protein | | -1.362877828 |
| GRMZM2G05 | | | |
| 0774 | hypothetical protein LOC100274803 | | -1.409873615 |
| GRMZM2G05 | | | |
| 1101 | Putative uncharacterized protein | | 1.695195843 |
| GRMZM2G05 | | | |
| 2034 | Hypothetical protein LOC100272854 | | 1.109560293 |
| GRMZM2G05 | | | |
| 2344 | RING-H2 finger protein ATL2B | | 1.326378837 |
| GRMZM2G05 | | | |
| 2688 | ATBRCA1 | | 2.171478176 |
| GRMZM2G05 | | | |
| 3027 | hypothetical protein LOC100194362 | | -1.640501089 |
| GRMZM2G05 | | | |
| | Putative RING zinc finger domain superfamily protein isoform 1 | | 1.271818573 |

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| 3210 | | |
| GRMZM2G05 | | |
| 3303 | LOC100285270 | 2.934965937 |
| GRMZM2G05 | | |
| 3511 | hypothetical protein LOC100194163 | -1.238979843 |
| GRMZM2G05 | | |
| 3707 | unknown | 7.337414843 |
| GRMZM2G05 | | |
| 3909 | Putative uncharacterized protein Zinc finger, C3HC4 type family protein ; | 1.516399067 |
| GRMZM2G05 | | |
| 5037 | ubiquitin-protein ligase/ zinc ion binding protein | 1.467482969 |
| GRMZM2G05 | | |
| 5643 | Putative uncharacterized protein | -1.00014807 |
| GRMZM2G05 | | |
| 5973 | hypothetical protein LOC100274339 | 2.088341148 |
| GRMZM2G05 | | |
| 6270 | RING finger and CHY zinc finger domain-containing protein 1 (LOC100282790), mRNA | 1.931925717 |
| GRMZM2G05 | | |
| 8450 | hypothetical protein LOC100192826 | -2.827971492 |
| GRMZM2G05 | | |
| 9110 | Putative RING zinc finger domain superfamily protein | -1.362877828 |
| GRMZM2G06 | | |
| 1624 | Putative uncharacterized protein SINA4 Ubiquitin ligase SINAT4 | 1.104040925 |
| GRMZM2G06 | | |
| 1663 | Putative RING zinc finger domain superfamily protein | -2.044316741 |
| GRMZM2G06 | | |
| 1980 | Putative uncharacterized protein Zinc finger, C3HC4 type family protein | 1.209314669 |
| GRMZM2G06 | | |
| 2724 | Putative uncharacterized protein | -13.35620271 |
| GRMZM2G06 | | |
| 4580 | hypothetical protein LOC100382007 | 1.021715293 |
| GRMZM2G06 | | |
| 5893 | Hypothetical protein LOC100279516 | 1.59696676 |

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|-----------|------|--|--------------|
| GRMZM2G06 | 6169 | hypothetical protein LOC100191553 | 1.415072863 |
| GRMZM2G06 | 6171 | hypothetical protein LOC100381983 | 1.971930239 |
| GRMZM2G06 | 8128 | Putative uncharacterized protein RING-H2 finger protein ATL2M | -2.877186525 |
| GRMZM2G06 | 8239 | Putative RING zinc finger domain superfamily protein | -11.58446153 |
| GRMZM2G06 | 8590 | inhibitor of apoptosis-like protein | -1.168180995 |
| GRMZM2G06 | 9162 | Putative uncharacterized protein | 1.108099384 |
| GRMZM2G06 | 9215 | Zinc finger, C3HC4 type family protein | 1.287054735 |
| GRMZM2G06 | 9923 | hypothetical protein LOC100383370 | -3.167770086 |
| GRMZM2G06 | 9928 | unknown | 1.619291551 |
| GRMZM2G07 | 1277 | RING zinc finger protein-like | 7.337414843 |
| GRMZM2G07 | 1602 | Putative uncharacterized protein | -1.544594871 |
| GRMZM2G07 | 1613 | PHD-finger family protein | 1.724292488 |
| GRMZM2G07 | 2462 | hypothetical protein LOC100191292 | -1.40881753 |
| GRMZM2G07 | 3228 | hypothetical protein LOC100193125 | -2.516082143 |
| GRMZM2G07 | 4254 | hypothetical protein LOC100381693 | -1.035787149 |
| GRMZM2G07 | 5019 | Putative uncharacterized protein | 1.254461247 |
| GRMZM2G07 | | Putative uncharacterized protein RING finger and CHY zinc finger domain-containing | 1.626498151 |

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|-----------|---|--------------|
| 7307 | protein 1 | |
| GRMZM2G07 | | |
| 7809 | hypothetical protein LOC100279782 | 1.0723914 |
| GRMZM2G07 | | |
| 8526 | Putative uncharacterized protein Ring domain containing protein | -4.542926092 |
| GRMZM2G08 | | |
| 0079 | Putative uncharacterized protein RING-H2 finger protein ATL1Q | 1.677123393 |
| GRMZM2G08 | | |
| 1060 | Zinc finger, C3HC4 type family protein | 1.907727859 |
| GRMZM2G08 | | |
| 1075 | Putative uncharacterized protein | 1.769611815 |
| GRMZM2G08 | | |
| 1350 | hypothetical protein LOC100382524 | 1.356919183 |
| GRMZM2G08 | | |
| 1829 | Putative uncharacterized protein | -1.26233766 |
| GRMZM2G08 | | |
| 1912 | hypothetical protein LOC100274494 | 2.230574112 |
| GRMZM2G08 | | |
| 1965 | hypothetical protein LOC100276574 | -1.348063938 |
| GRMZM2G08 | | |
| 2580 | hypothetical protein LOC100191657 | 2.934965937 |
| GRMZM2G08 | | |
| 3382 | unknown | -1.362877828 |
| GRMZM2G08 | | |
| 4819 | hypothetical protein LOC100193494 | 1.39488118 |
| GRMZM2G08 | | |
| 5948 | protein binding protein | 1.462687273 |
| GRMZM2G08 | | |
| 7787 | Uncharacterized protein | 1.399543942 |
| GRMZM2G08 | | |
| 9466 | hypothetical protein LOC100383634 | -1.067282445 |
| GRMZM2G09 | | |
| 2244 | hypothetical protein LOC100193667 | 4.236765345 |

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|-----------|------|---|--------------|
| GRMZM2G09 | 5025 | Putative RING zinc finger domain superfamily protein | -4.088633483 |
| GRMZM2G09 | 5873 | protein binding protein | -4.088633483 |
| GRMZM2G09 | 6281 | Putative uncharacterized protein | -1.362877828 |
| GRMZM2G09 | 8637 | hypothetical protein LOC100191926 | 1.577544191 |
| GRMZM2G09 | 9238 | hypothetical protein LOC100192691 | -8.177266965 |
| GRMZM2G10 | 1852 | Ubiquitin ligase SINAT3 | -1.143058823 |
| GRMZM2G10 | 2243 | unknown | 1.238728271 |
| GRMZM2G10 | 3245 | Putative uncharacterized protein Ubiquitin-protein ligase/ zinc ion binding protein | 1.619291551 |
| GRMZM2G10 | 5460 | RING-H2 finger protein ATL3B | -4.088633483 |
| GRMZM2G10 | 5770 | unknown | 3.660554738 |
| GRMZM2G10 | 6377 | hypothetical protein LOC100278311 | -1.362877828 |
| GRMZM2G10 | 7463 | Putative uncharacterized protein | -1.54350019 |
| GRMZM2G10 | 8084 | Zinc finger, C3HC4 type family protein | 1.173986375 |
| GRMZM2G10 | 8085 | RING-H2 finger protein ATL1G | 1.399227947 |
| GRMZM2G11 | 0423 | hypothetical protein LOC100279995 | -4.429352939 |
| GRMZM2G11 | 1614 | Putative uncharacterized protein | -1.492675716 |
| GRMZM2G11 | | Putative uncharacterized protein | 1.385956137 |

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| 3002 | | |
| GRMZM2G11 | | |
| 3039 | Putative uncharacterized protein Ubiquitin-protein ligase/ zinc ion binding protein | -1.265529411 |
| GRMZM2G11 | | |
| 3137 | cellulose synthase 6 | 2.171239825 |
| GRMZM2G11 | | |
| 3295 | RING zinc finger protein-like | -1.316678579 |
| GRMZM2G11 | | |
| 6574 | hypothetical protein LOC100382051 | -1.007344481 |
| GRMZM2G11 | | |
| 6714 | hypothetical protein LOC100193229 | 2.875473384 |
| GRMZM2G11 | | |
| 6952 | hypothetical protein LOC100279906 | 2.534743309 |
| GRMZM2G11 | | |
| 7612 | LOC100279085 | -1.240994445 |
| GRMZM2G11 | | |
| 8265 | Putative uncharacterized protein | 1.822768319 |
| GRMZM2G11 | | |
| 8344 | hypothetical protein LOC100381884 | -1.111424354 |
| GRMZM2G11 | | |
| 8385 | Putative uncharacterized protein Ubiquitin-protein ligase/ zinc ion binding protein | 1.244170343 |
| GRMZM2G11 | | |
| 9930 | Putative uncharacterized protein Zinc finger, RING-type | -1.282403137 |
| GRMZM2G12 | | |
| 0816 | RING-finger protein like | 1.178588238 |
| GRMZM2G12 | | |
| 2284 | RING-H2 finger protein ATL2C | -24.5318009 |
| GRMZM2G12 | | |
| 2848 | hypothetical protein LOC100217052 | -12.26590045 |
| GRMZM2G12 | | |
| 3212 | ubiquitin-protein ligase CIP8 | -2.044316741 |
| GRMZM2G12 | | |
| 3660 | HEAT/U-box domain-containing protein | -1.141815799 |

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|-----------|------|--|--------------|
| GRMZM2G12 | 3791 | RNA-binding region-containing protein 1 | -1.26375944 |
| GRMZM2G12 | 4441 | RING finger protein 126 | 1.926425519 |
| GRMZM2G12 | 4701 | C-terminal zinc-finger | -1.444001508 |
| GRMZM2G12 | 4915 | Putative uncharacterized protein Ubiquitin ligase SINAT3 | -1.07595618 |
| GRMZM2G12 | 5867 | ubiquitin-protein ligase/ zinc ion binding protein | 1.467482969 |
| GRMZM2G12 | 6795 | Putative uncharacterized protein | -1.187022624 |
| GRMZM2G12 | 9150 | RING finger protein 5 | 2.81267569 |
| GRMZM2G12 | 9585 | Putative uncharacterized protein | 2.527331779 |
| GRMZM2G13 | 0167 | unknown | 7.337414843 |
| GRMZM2G13 | 1245 | ubiquitin-protein ligase/ zinc ion binding protein | 1.948210148 |
| GRMZM2G13 | 1591 | RNA-binding protein | 1.163504354 |
| GRMZM2G13 | 3396 | Protein binding protein Putative uncharacterized protein | -1.542368629 |
| GRMZM2G13 | 4023 | hypothetical protein LOC100217252 | 1.712063463 |
| GRMZM2G13 | 5866 | Putative uncharacterized protein | 2.03817079 |
| GRMZM2G13 | 5909 | hypothetical protein LOC100304260 | 12.54697938 |
| GRMZM2G13 | 6293 | Putative RING zinc finger domain superfamily protein | -1.014783491 |
| GRMZM2G13 | | protein binding protein | -5.062117645 |

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| 8997 | | |
| GRMZM2G13 | | |
| 9369 | Putative uncharacterized protein | 1.391904447 |
| GRMZM2G13 | | |
| 9941 | Protein binding protein | 1.222902474 |
| GRMZM2G14 | | |
| 0160 | protein binding protein | 1.08130324 |
| GRMZM2G14 | | |
| 0651 | RING-H2 finger protein ATL1Q | -1.168180995 |
| GRMZM2G14 | | |
| 0924 | zinc finger, C3HC4 type family protein | 1.467482969 |
| GRMZM2G14 | | |
| 1216 | Zinc finger, C3HC4 type family protein | -1.422133385 |
| GRMZM2G14 | | |
| 1379 | hypothetical protein LOC100383409 | -1.163432292 |
| GRMZM2G14 | | |
| 1596 | CONSTANS interacting protein 4 | -1.362877828 |
| GRMZM2G14 | | |
| 1922 | Putative uncharacterized protein | -1.417392941 |
| GRMZM2G14 | | |
| 3644 | unknown | 1.027238078 |
| GRMZM2G14 | Putative uncharacterized protein RING finger and CHY zinc finger domain-containing protein 1 | -7.229178042 |
| 4782 | | |
| GRMZM2G14 | | |
| 5123 | hypothetical protein LOC100194220 | 18.34353711 |
| GRMZM2G14 | | |
| 5374 | hypothetical protein LOC100381751 | -4.088633483 |
| GRMZM2G14 | | |
| 6267 | hypothetical protein LOC100273232 | 1.427764769 |
| GRMZM2G14 | | |
| 6354 | SINA2 Ubiquitin ligase SINAT2 | -2.299856334 |
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| 6847 | RING-H2 finger protein ATL1R | -1.362877828 |

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| 8249 | hypothetical protein LOC100276243 | | 1.136782581 |
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| 8908 | Putative uncharacterized protein Ubiquitin-protein ligase/ zinc ion binding protein | | 2.678156418 |
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| 9028 | Putative uncharacterized protein RING finger protein 5 | | -1.552166415 |
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| 1576 | CONSTANS interacting protein 4 | | 1.031391332 |
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| 1616 | hypothetical protein LOC100193862 | | -1.417392941 |
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| 2408 | Ubiquitin-protein ligase/ zinc ion binding protein | | 3.081714234 |
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| 2461 | RING finger protein 5 | | -1.703597284 |
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| 7855 | Putative uncharacterized protein | | 9.171768553 |
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| 7925 | Putative uncharacterized protein | | -1.039763935 |
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| 2356 | anaphase-promoting complex subunit 11 | -1.58093828 |
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| 2949 | RING zinc finger protein-like | -1.309431638 |
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| 4358 | Putative uncharacterized protein RHC1A | 1.354599663 |
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| 5044 | unknown | -1.817170437 |
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| 5063 | inhibitor of apoptosis-like protein | -1.192518099 |
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| 8690 | Zinc finger, C3HC4 type family protein | -2.521323981 |
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| 8707 | Putative uncharacterized protein Zinc finger, C3HC4 type family protein | -1.259368119 |
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| 9994 | hypothetical protein LOC100273064 | 4.769319648 |
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| 0137 | hypothetical protein LOC100193852 | 1.903761689 |
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| 0434 | hypothetical protein LOC100273142 | -1.061982723 |
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| 1232 | Putative uncharacterized protein | 1.354599663 |
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| 1277 | Putative uncharacterized protein | -1.362877828 |

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| GRMZM2G17 | 1561 | unknown | 1.467482969 |
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| GRMZM2G17 | 8522 | Putative uncharacterized protein | 3.668707421 |
| GRMZM2G18 | 0195 | Putative uncharacterized protein | 1.03343871 |
| GRMZM2G18 | 1519 | LOC100283384 | 1.444906307 |
| GRMZM2G30 | 0589 | hypothetical protein LOC100272564 | 1.400779197 |
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| 8408 | RING zinc finger protein-like | -2.385036198 |
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| 0399 | hypothetical protein LOC100382497 | 1.030232941 |
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| 4111 | RING-H2 finger protein ATL5H | 3.668707421 |
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| 4781 | Putative SNF2-domain/RING finger domain/helicase domain protein | -1.196673214 |
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| 0684 | unknown | -1.362877828 |
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| 6761 | Putative uncharacterized protein Zinc finger, C3HC4 type family protein | 1.271818573 |
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| 9151 | Putative RING finger U-box domain family protein | 1.827431621 |
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| 0444 | Putative RING zinc finger domain superfamily protein | -34.07194569 |
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| 1271 | hypothetical protein LOC100274688 | 1.156529328 |
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| 2891 | unknown | | -1.898294117 |
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| 6895 | RING-H2 finger protein ATL2M | | 1.467482969 |
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| 9505 | Putative uncharacterized protein | | 1.579139281 |
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| 1074 | Putative uncharacterized protein RING-box protein 1a | | 1.100612226 |
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| 3253 | hypothetical protein LOC100193628 | | 2.934965937 |
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| 4612 | Putative RING zinc finger domain superfamily protein | | -2.149153497 |
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| 5888 | RING/FYVE/PHD-type zinc finger family protein | | 1.970231763 |
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| 5153 | hypothetical protein LOC100191688 | | -2.725755655 |
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| 1386 | RNA polymerase T phage-like 1 | | 1.584214568 |
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| 2320 | hypothetical protein LOC100273800 | | 1.305811116 |
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| 3349 | protein binding protein | | -1.52807514 |
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| | hypothetical protein LOC100279601 | | -1.265529411 |

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| 9901 | | |
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| 0238 | Putative uncharacterized protein | 1.989521992 |
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| 0268 | RING finger protein 5 | -1.453736349 |
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| 1436 | protein binding protein | 2.494721046 |
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| 2341 | hypothetical protein LOC100275703 | 1.136968786 |
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| 9627 | hypothetical protein LOC100192498 | -1.413354784 |
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| 6216 | hypothetical protein LOC100384078 | -4.088633483 |
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| 7125 | Protein binding protein Putative uncharacterized protein | -1.090302262 |
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| 3956 | Putative uncharacterized protein | 2.288904253 |
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| 4582 | Uncharacterized protein | 1.338398819 |
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| 6613 | Hypothetical protein LOC100384773 | -1.362877828 |
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| 8179 | RING-H2 finger protein ATL2K | -5.45151131 |
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| | 9355 | hypothetical protein LOC100216734 | 1.473400239 |
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| | 6241 | hypothetical protein LOC100383358 | 4.383635021 |
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| | 1447 | hypothetical protein LOC100384551 | 1.781943605 |
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| | 8260 | Putative uncharacterized protein | -2.611654256 |
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| | 8553 | Ring-H2 zinc finger protein | 1.027238078 |
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| | 0106 | hypothetical protein LOC100277663 | -4.088633483 |
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| | 2046 | RING-H2 finger protein ATL2M | 1.956643958 |
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| | 7897 | Putative RING zinc finger domain superfamily protein | 1.375765283 |
| | GRMZM2G70 | | |
| | 4032 | Putative zinc-finger protein Fragment | -1.382773854 |
| | GRMZM2G02 | | |
| E3 ubiquitin ligases_HECT | 1299 | hypothetical protein LOC100304346 | 1.116645138 |
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| | 4622 | Putative uncharacterized protein | -1.120173557 |
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| | 9141 | hypothetical protein LOC100382342 | 1.403226318 |
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| | | Putative uncharacterized protein | 1.441737653 |

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| | 0439 | | |
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| | 1536 | unknown | 1.21790785 |
| | GRMZM2G46 | | |
| | 1948 | ubiquitin-protein ligase 7 | 1.778525554 |
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| E3 ubiquitin ligases_BT | 0261 | voltage-gated potassium channel complex | -3.180048264 |
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| | 0623 | Elongin C | 3.668707421 |
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| | 0936 | hypothetical protein LOC100192477 | 3.104674852 |
| | GRMZM2G00 | | |
| | 6424 | Hypothetical protein LOC100276863 | -1.946968325 |
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| | 9724 | Putative uncharacterized protein Speckle-type POZ protein | 1.645359692 |
| | GRMZM2G01 | | |
| | 7404 | Putative uncharacterized protein | 2.043994135 |
| | GRMZM2G01 | | |
| | 7486 | Putative uncharacterized protein | 2.445804948 |
| | GRMZM2G02 | | |
| | 0156 | Protein binding protein Putative uncharacterized protein | -13.62877828 |
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| | 3346 | hypothetical protein LOC100279937 | 2.384659824 |
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| | 7688 | hypothetical protein LOC100275864 | 1.467482969 |

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| 9307 | Putative uncharacterized protein | | 1.956643958 |
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| 3267 | hypothetical protein LOC100191409 | | -12.26590045 |
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| 8691 | GAMYB-binding protein | | 1.400779197 |
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| 9280 | Ethylene-overproduction protein 1 | | 2.614787835 |
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| 0115 | Putative uncharacterized protein | | 7.704285585 |
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| 5257 | voltage-gated potassium channel complex | | 1.366277247 |
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| 8281 | Putative uncharacterized protein | | 2.132436189 |
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| 5785 | cellulose synthase catalytic subunit 11 | | -1.698929895 |
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| 8531 | hypothetical protein LOC100273151 | | 2.078934205 |
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| 9282 | Elongin C | | -1.424268721 |
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| 9865 | hypothetical protein LOC100382519 | | 3.250983309 |
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| 0765 | Hypothetical protein LOC100381943 | | -1.639712386 |
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| 7053 | Hypothetical protein LOC100279255 | | -6.814389138 |
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| 4323 | LOC100284563 | | -1.014909021 |
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| 6450 | Regulatory protein NPR1 | | 1.169627515 |
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| GRMZM2G08 | unknown | | -1.934407239 |

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| 8086 | Putative uncharacterized protein Speckle-type POZ protein | 5.869931874 |
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| 5510 | LOC100282480 | 1.712063463 |
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| 8227 | hypothetical protein LOC100279213 | -1.081003309 |
| GRMZM2G10 | | |
| 0946 | Uncharacterized protein | 1.058816825 |
| GRMZM2G11 | | |
| 0531 | Putative uncharacterized protein | 1.035870331 |
| GRMZM2G11 | | |
| 5162 | hypothetical protein LOC100384298 | 1.981102008 |
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| 8082 | hypothetical protein LOC100279911 | -1.154804877 |
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| 8485 | hypothetical protein LOC100194212 | 2.868262166 |
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| 0505 | BTB/POZ domain containing protein | 2.201224453 |
| GRMZM2G14 | | |
| 2825 | Putative uncharacterized protein | 1.971031046 |
| GRMZM2G14 | | |
| 3782 | LOC100283633 | 1.712063463 |
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| 8213 | hypothetical protein LOC100191618 | -1.166173811 |
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| 4149 | hypothetical protein LOC100280048 | -1.409873615 |
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| 4437 | hypothetical protein LOC100193156 | 1.801001825 |
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| 7379 | voltage-gated potassium channel complex | 1.124029508 |
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| 9161 | hypothetical protein LOC100191465 | -1.362877828 |

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| 9782 | hypothetical protein LOC100191918 | | -19.08028959 |
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| 2210 | hypothetical protein LOC100272403 | | -1.101395454 |
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| 2376 | hypothetical protein LOC100274431 | | -1.530903861 |
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| 2506 | hypothetical protein LOC100280174 | | 5.13619039 |
| GRMZM2G30 | | | |
| 1803 | hypothetical protein LOC100192849 | | -1.47645098 |
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| 0703 | Putative uncharacterized protein TD and POZ domain-containing protein 1 | | 1.138564372 |
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| 0711 | hypothetical protein LOC100279559 | | 1.32234729 |
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| 3024 | unknown | | 3.668707421 |
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| 7948 | unknown | | 1.362662757 |
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| 6964 | seven-transmembrane-domain protein 1 | | -9.540144793 |
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| E3 ubiquitin ligases_F Box | AC149829.2_F | | |
| | G006 | Uncharacterized protein | 1.859367625 |
| | AC190750.2_F | | |
| | G014 | F-box domain containing protein | -1.06351738 |
| | AC194341.4_F | | |
| | G004 | hypothetical protein LOC100279285 | -1.233079939 |
| | AC204868.3_F | | |
| | G004 | Putative F-box containing family protein | -1.362877828 |
| | AC207342.3_F | | |
| | G007 | F-box domain containing protein | 1.809895661 |
| | AC214635.3_F | | |
| | G002 | LOC100281539 | 1.086501813 |
| | AC233942.1_F | | |
| | G001 | Hypothetical protein LOC100382855 | -1.779312719 |
| | GRMZM2G00 | | |
| | 1272 | Putative uncharacterized protein | 1.427460706 |
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| | 1639 | hypothetical protein LOC100193825 | -2.131680705 |
| GRMZM2G00 | | | |
| 2427 | Ubiquitin-protein ligase | -1.111821386 | |
| GRMZM2G00 | | | |
| 3663 | Kelch motif family protein Putative uncharacterized protein | -1.250860472 | |
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| 4592 | F-box domain containing protein Putative uncharacterized protein | 1.281464001 | |
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| 5486 | F-box domain containing protein Putative uncharacterized protein | 1.801001825 | |
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| 5622 | Putative uncharacterized protein | 2.379101176 | |
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| 9021 | unknown | 2.503353299 | |
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| 9717 | Uncharacterized protein | 1.188661205 | |

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| 0551 | Putative uncharacterized protein | | 1.007096155 |
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| 1627 | Putative uncharacterized protein | | -1.566772936 |
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| 2393 | F-box protein interaction domain containing protein | | 2.971653011 |
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| 2821 | Uncharacterized protein | | 2.568095195 |
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| 6878 | hypothetical protein LOC100193490 | | -1.749026545 |
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| 7933 | Putative uncharacterized protein | | 1.99314851 |
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| 0366 | Putative uncharacterized protein | | 1.10780577 |
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| 0594 | F-box domain containing protein | | 1.808148658 |
| GRMZM2G02 | | | |
| 4806 | Putative uncharacterized protein | | -1.941068421 |
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| 5783 | hypothetical protein LOC100384515 | | -6.294017603 |
| GRMZM2G02 | | | |
| 6229 | hypothetical protein LOC100216784 | | 4.402448906 |
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| 8014 | hypothetical protein LOC100273165 | | -1.908028959 |
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| 8796 | Uncharacterized protein | | 1.100612226 |
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| 9039 | Kelch motif family protein Putative uncharacterized protein | | 3.815455718 |
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| 9478 | F-box domain containing protein | | 1.058184998 |
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| | hypothetical protein LOC100192018 | | -1.362877828 |

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| 0823 | | |
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| 3027 | hypothetical protein LOC100383592 | 1.192329912 |
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| 4748 | unknown | 1.033160655 |
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| 5243 | kelch motif family protein | -1.21019027 |
| GRMZM2G03 | | |
| 7882 | hypothetical protein LOC100277619 | 3.616297315 |
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| 8839 | hypothetical protein LOC100383249 | -3.407194569 |
| GRMZM2G04 | | |
| 0182 | Hypothetical protein LOC100384416 | 1.438133309 |
| GRMZM2G04 | | |
| 1048 | LOC100285522 | 1.614231265 |
| GRMZM2G04 | | |
| 1959 | hypothetical protein LOC100382458 | -1.221890466 |
| GRMZM2G04 | | |
| 2752 | unknown | -1.060016088 |
| GRMZM2G04 | | |
| 4388 | hypothetical protein LOC100274439 | -3.35359825 |
| GRMZM2G04 | | |
| 5820 | hypothetical protein LOC100279556 | 1.002183491 |
| GRMZM2G04 | | |
| 6816 | hypothetical protein LOC100193930 | 4.668726057 |
| GRMZM2G04 | | |
| 7777 | F-box domain containing protein Putative uncharacterized protein | 1.222902474 |
| GRMZM2G04 | | |
| 8661 | Putative uncharacterized protein | 1.31025265 |
| GRMZM2G04 | | |
| 8665 | RNI-like superfamily protein | -1.238979843 |
| GRMZM2G04 | | |
| 9364 | hypothetical protein LOC100383281 | 1.260530242 |

| | | | |
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| GRMZM2G05 | | | |
| 1090 | hypothetical protein LOC100279741 | | 1.767649939 |
| GRMZM2G05 | | | |
| 2268 | F-box domain containing protein | | 1.467482969 |
| GRMZM2G05 | | | |
| 4032 | F-box protein | | -2.725755655 |
| GRMZM2G05 | | | |
| 9799 | Ethylene-responsive protein | | 2.515685089 |
| GRMZM2G06 | | | |
| 0257 | ATPP2-A13 | | -1.035787149 |
| GRMZM2G06 | | | |
| 0276 | hypothetical protein LOC100382494 | | 1.259820284 |
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| 4954 | Uncharacterized protein | | 1.616867462 |
| GRMZM2G06 | | | |
| 5970 | unknown | | 1.467482969 |
| GRMZM2G06 | | | |
| 7460 | Hypothetical protein LOC100381788 | | -1.121355175 |
| GRMZM2G06 | | | |
| 7626 | hypothetical protein LOC100192470 | | -4.088633483 |
| GRMZM2G06 | | | |
| 8586 | hypothetical protein LOC100193706 | | 1.602251813 |
| GRMZM2G06 | | | |
| 9649 | F-box family member | | -1.128210122 |
| GRMZM2G07 | | | |
| 1113 | hypothetical protein LOC100192671 | | 1.510644232 |
| GRMZM2G07 | | | |
| 1705 | cyclin-like F-box | | 7.337414843 |
| GRMZM2G07 | | | |
| 1997 | Putative uncharacterized protein | | 1.605059497 |
| GRMZM2G07 | | | |
| 2028 | hypothetical protein LOC100216622 | | 2.641469343 |
| GRMZM2G07 | | | |
| | hypothetical protein LOC100274878 | | 4.402448906 |

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|-----------|--|--------------|
| 2586 | | |
| GRMZM2G07 | | |
| 4245 | hypothetical protein LOC100277288 | -2.306408631 |
| GRMZM2G07 | | |
| 8198 | Putative uncharacterized protein Transferase, transferring glycosyl groups | 1.448669084 |
| GRMZM2G07 | | |
| 9031 | unknown | 1.164203155 |
| GRMZM2G08 | | |
| 1032 | unknown | 2.934965937 |
| GRMZM2G08 | | |
| 1172 | hypothetical protein LOC100275642 | 1.222902474 |
| GRMZM2G08 | | |
| 2346 | hypothetical protein LOC100276415 | 2.934965937 |
| GRMZM2G08 | | |
| 2853 | hypothetical protein LOC100381683 | 1.177043631 |
| GRMZM2G08 | | |
| 2964 | F-box domain containing protein | -1.362877828 |
| GRMZM2G08 | | |
| 4035 | F-box domain containing protein | 1.065672156 |
| GRMZM2G08 | | |
| 8482 | ATPP2-A13 | -13.62877828 |
| GRMZM2G09 | | |
| 0104 | Putative uncharacterized protein | 1.027238078 |
| GRMZM2G09 | | |
| 1293 | hypothetical protein LOC100384571 | 1.254461247 |
| GRMZM2G10 | | |
| 0121 | unknown | 1.076154177 |
| GRMZM2G10 | | |
| 1036 | F-box domain containing protein | 3.179546432 |
| GRMZM2G10 | | |
| 1060 | Putative uncharacterized protein | -1.253847601 |
| GRMZM2G10 | | |
| 1545 | hypothetical protein LOC100193191 | 3.668707421 |

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|-----------|------|--|--------------|
| GRMZM2G10 | 2189 | kelch motif family protein | -1.312400871 |
| GRMZM2G10 | 4882 | Hypothetical protein LOC100194140 | 1.956643958 |
| GRMZM2G10 | 6363 | hypothetical protein LOC100279726 | -3.469143561 |
| GRMZM2G10 | 7945 | hypothetical protein LOC100383277 | -1.066600039 |
| GRMZM2G10 | 8228 | LOC100281288 | 1.070039665 |
| GRMZM2G10 | 9140 | ubiquitin-protein ligase | -2.33636199 |
| GRMZM2G11 | 0057 | unknown | -1.55757466 |
| GRMZM2G11 | 0330 | unknown | -1.362877828 |
| GRMZM2G11 | 3244 | hypothetical protein LOC100276321 | 2.040718503 |
| GRMZM2G11 | 5701 | hypothetical protein LOC100273859 | 4.6470294 |
| GRMZM2G11 | 5998 | hypothetical protein LOC100194199 | 1.699190806 |
| GRMZM2G11 | 6603 | F-box domain containing protein | -2.385036198 |
| GRMZM2G11 | 7633 | Putative uncharacterized protein | -1.267237278 |
| GRMZM2G11 | 8109 | hypothetical protein LOC100194002 | 26.41469343 |
| GRMZM2G11 | 9650 | F-box domain containing protein Putative uncharacterized protein | 1.731629903 |
| GRMZM2G11 | 9932 | Uncharacterized protein | -2.141665158 |
| GRMZM2G12 | | F-box family protein Fragment | 4.483975737 |

| | | | |
|-----------|---|--|--------------|
| 0408 | | | |
| GRMZM2G12 | | | |
| 3128 | lysM domain containing protein | | -1.734571781 |
| GRMZM2G12 | | | |
| 5411 | hypothetical protein LOC100382859 | | -2.964259275 |
| GRMZM2G12 | | | |
| 6920 | hypothetical protein LOC100384433 | | -1.362877828 |
| GRMZM2G12 | | | |
| 8215 | F-box protein interaction domain containing protein | | -1.362877828 |
| GRMZM2G12 | | | |
| 9288 | Hypothetical protein LOC100383825 | | -1.207120362 |
| GRMZM2G13 | | | |
| 0109 | hypothetical protein LOC100193239 | | 1.167996648 |
| GRMZM2G13 | | | |
| 2913 | F-box domain containing protein | | -1.362877828 |
| GRMZM2G13 | | | |
| 3021 | hypothetical protein LOC100382330 | | 1.280304018 |
| GRMZM2G13 | | | |
| 3428 | hypothetical protein LOC100273107 | | -25.21323981 |
| GRMZM2G13 | | | |
| 3895 | hypothetical protein LOC100383858 | | 9.171768553 |
| GRMZM2G13 | | | |
| 4550 | Putative uncharacterized protein | | 1.051331082 |
| GRMZM2G13 | | | |
| 5002 | hypothetical protein LOC100273406 | | -1.146056355 |
| GRMZM2G13 | | | |
| 5978 | hypothetical protein LOC100274630 | | 1.868481222 |
| GRMZM2G13 | | | |
| 7029 | Uncharacterized protein | | 1.510644232 |
| GRMZM2G13 | | | |
| 7451 | hypothetical protein LOC100216731 | | 1.343818673 |
| GRMZM2G13 | | | |
| 7582 | LOC100281166 | | 1.467482969 |

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|-----------|--|--|--------------|
| GRMZM2G13 | | | |
| 9066 | F-box domain containing protein | | 1.614231265 |
| GRMZM2G14 | | | |
| 1472 | hypothetical protein LOC100274409 | | -1.362877828 |
| GRMZM2G14 | | | |
| 2043 | Uncharacterized protein | | 1.231961011 |
| GRMZM2G14 | | | |
| 4615 | hypothetical protein LOC100272343 | | -1.542481882 |
| GRMZM2G14 | | | |
| 6694 | unknown | | 1.956643958 |
| GRMZM2G14 | | | |
| 7402 | hypothetical protein LOC100193397 | | 1.073930718 |
| GRMZM2G14 | | | |
| 7800 | unknown | | 1.020567701 |
| GRMZM2G14 | | | |
| 9153 | Uncharacterized protein | | 1.191978503 |
| GRMZM2G15 | | | |
| 0169 | unknown | | 1.236490279 |
| GRMZM2G15 | | | |
| 1496 | hypothetical protein LOC100382223 | | 1.926071396 |
| GRMZM2G15 | | | |
| 2290 | Putative uncharacterized protein | | -1.548724804 |
| GRMZM2G15 | | | |
| 5849 | transport inhibitor response 1 protein | | -1.829317298 |
| GRMZM2G15 | | | |
| 6490 | hypothetical protein LOC100382083 | | -1.567309502 |
| GRMZM2G15 | | | |
| 6506 | hypothetical protein LOC100304291 | | -2.271463046 |
| GRMZM2G15 | | | |
| 7132 | hypothetical protein LOC100191208 | | -1.943362828 |
| GRMZM2G15 | | | |
| 7631 | F-box domain containing protein | | -3.738179184 |
| GRMZM2G16 | Putative uncharacterized protein | | 1.39082341 |

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|-----------|--|--|--------------|
| 3726 | | | |
| GRMZM2G16 | | | |
| 5007 | hypothetical protein LOC100274214 | | 2.538348919 |
| GRMZM2G16 | | | |
| 9227 | F-box domain containing protein | | 2.934965937 |
| GRMZM2G17 | | | |
| 1022 | F-box domain containing protein | | 2.934965937 |
| GRMZM2G17 | | | |
| 1713 | 6-phosphofructokinase complex | | 2.201224453 |
| GRMZM2G17 | | | |
| 6340 | hypothetical protein LOC100191954 | | 2.777735619 |
| GRMZM2G17 | | | |
| 6638 | Uncharacterized protein | | 2.690385442 |
| GRMZM2G17 | | | |
| 9532 | F-box domain containing protein Putative uncharacterized protein | | 1.274393104 |
| GRMZM2G18 | | | |
| 0458 | Putative uncharacterized protein | | -2.11161935 |
| GRMZM2G30 | | | |
| 5864 | Lipid binding protein | | 6.918133994 |
| GRMZM2G31 | | | |
| 3041 | unknown | | -1.42482682 |
| GRMZM2G31 | | | |
| 7262 | Uncharacterized protein | | -2.725755655 |
| GRMZM2G33 | | | |
| 0526 | Cyclin-like F-box | | 1.318017111 |
| GRMZM2G36 | | | |
| 0352 | Uncharacterized protein | | -1.294733936 |
| GRMZM2G36 | | | |
| 5677 | F-box protein interaction domain containing protein | | 3.197016467 |
| GRMZM2G37 | | | |
| 7373 | unknown | | -1.362877828 |
| GRMZM2G37 | | | |
| 9804 | unknown | | 1.19059939 |

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| E3 ubiquitin ligases_U Box | GRMZM2G40 | | |
| | 5474 | hypothetical protein LOC100274552 | 1.320734672 |
| | GRMZM2G43 | | |
| | 4518 | Putative uncharacterized protein | 2.005560057 |
| | GRMZM2G43 | | |
| | 5445 | hypothetical protein LOC100273081 | -1.879119429 |
| | GRMZM2G44 | | |
| | 2489 | hypothetical protein LOC100273804 | 1.180366736 |
| | GRMZM2G44 | | |
| | 3889 | unknown | 1.834353711 |
| | GRMZM2G44 | | |
| | 7480 | Uncharacterized protein | 3.668707421 |
| | GRMZM2G45 | | |
| | 9166 | F-box protein GID2 | 2.934965937 |
| | GRMZM2G70 | | |
| | 2889 | Putative uncharacterized protein | -1.263258453 |
| | GRMZM2G00 | | |
| | 7486 | ubiquitin ligase complex | 1.074715468 |
| | GRMZM2G01 | | |
| | 8059 | ubiquitin ligase complex | 7.92440803 |
| GRMZM2G01 | | | |
| 9777 | Uncharacterized protein | -3.407194569 | |
| GRMZM2G02 | | | |
| 0196 | Uncharacterized protein | -1.265529411 | |
| GRMZM2G02 | | | |
| 5037 | Putative ARM repeat-containing protein containing family protein | 1.001991059 | |
| GRMZM2G02 | | | |
| 5214 | STIP1 homology and U box-containing protein 1 | 1.19059939 | |
| GRMZM2G02 | | | |
| 7375 | unknown | -7.268681747 | |
| GRMZM2G03 | | | |
| 0805 | LOC100276970 | 1.195288547 | |
| GRMZM2G03 | LOC100273990 | 2.013886202 | |

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|-----------|--|--------------|
| 3521 | | |
| GRMZM2G03 | | |
| 7698 | pre-mRNA-splicing factor 19 | 2.48223183 |
| GRMZM2G05 | | |
| 0734 | LOC100281409 | 1.570464229 |
| GRMZM2G05 | | |
| 5052 | Putative uncharacterized protein | 1.222902474 |
| GRMZM2G05 | | |
| 7436 | Putative ARM repeat-containing protein containing family protein isoform 1 | 1.539823678 |
| GRMZM2G05 | | |
| 9042 | photoperiod responsive protein | -3.270906786 |
| GRMZM2G06 | | |
| 3394 | Uncharacterized protein | 1.124029508 |
| GRMZM2G06 | | |
| 5612 | ubiquitin-protein ligase | 3.668707421 |
| GRMZM2G07 | | |
| 3310 | Uncharacterized protein | 1.781943605 |
| GRMZM2G07 | | |
| 5104 | Uncharacterized protein | 1.385956137 |
| GRMZM2G09 | | |
| 2550 | unknown | 3.179546432 |
| GRMZM2G10 | | |
| 0090 | ubiquitin-protein ligase | -1.817170437 |
| GRMZM2G10 | | |
| 4769 | Putative uncharacterized protein STIP1 homology and U box-containing protein 1 | 1.895498834 |
| GRMZM2G11 | | |
| 5000 | hypothetical protein LOC100383373 | 1.237289562 |
| GRMZM2G12 | | |
| 5034 | Uncharacterized protein | 3.668707421 |
| GRMZM2G12 | | |
| 7690 | Uncharacterized protein | -4.088633483 |
| GRMZM2G15 | | |
| 2857 | ubiquitin ligase complex | -1.49916561 |

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|--------------------------|-------------------|--|--------------|
| | GRMZM2G15 2919 | hypothetical protein LOC100383857 | 1.877013099 |
| | GRMZM2G16 0370 | hypothetical protein LOC100381946 | 3.410906359 |
| | GRMZM2G30 3964 | U-box domain containing protein | -5.45151131 |
| | GRMZM2G30 4010 | Putative RING finger and ARM repeat-containing protein containing family protein | 1.385956137 |
| | GRMZM2G30 5822 | Putative U-box domain protein kinase family | -1.728835763 |
| | GRMZM2G30 7567 | Uncharacterized protein | -1.109665554 |
| | GRMZM2G31 4412 | unknown | -4.770072396 |
| | GRMZM2G32 4540 | hypothetical protein LOC100191855 | 1.880858453 |
| | GRMZM2G37 6085 | unknown | -1.124374208 |
| | GRMZM2G38 9462 | unknown | 1.687605414 |
| | GRMZM2G42 5965 | LOC100281122 | -3.407194569 |
| | GRMZM2G42 6271 | Hypothetical protein LOC100193745 | 3.268484794 |
| | GRMZM2G43 3433 | Putative U-box domain protein kinase family | 9.538639295 |
| | GRMZM2G45 2016 | hypothetical protein LOC100279362 | -1.158446153 |
| | GRMZM2G47 1733 | hypothetical protein LOC100193248 | 3.301836679 |
| | GRMZM2G47 6914 | ubiquitin-protein ligase | 2.65981288 |
| E3 ubiquitin ligases_DDB | AC149475.2_F | proteasome subunit alpha type 5 | 1.962609336 |

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| G003 | | |
| GRMZM2G00 | | |
| 5080 | Proteasome subunit alpha type (EC 3.4.25.1) | -1.86821455 |
| GRMZM2G01 | | |
| 6511 | maize 20S proteasome alpha subunit | 1.612211793 |
| GRMZM2G02 | | |
| 7282 | hypothetical protein LOC100273594 | 1.047923343 |
| GRMZM2G02 | | |
| 9583 | 26S proteasome non-ATPase regulatory subunit 6 | 1.928302012 |
| GRMZM2G03 | | |
| 3626 | 26S proteasome non-ATPase regulatory subunit 14 | 1.586790527 |
| GRMZM2G03 | | |
| 8126 | 26S proteasome regulatory complex ATPase RPT3 | 1.109210759 |
| GRMZM2G05 | | |
| 1790 | hypothetical protein LOC100273813 | 2.736657428 |
| GRMZM2G05 | | |
| 6569 | Putative uncharacterized protein | 1.042449792 |
| GRMZM2G05 | | |
| 6870 | proteasome subunit alpha type 5 | 2.695589283 |
| GRMZM2G06 | | |
| 1745 | hypothetical protein LOC100274928 | 1.119071132 |
| GRMZM2G07 | | |
| 4037 | Hypothetical protein LOC100273945 | 1.247360523 |
| GRMZM2G07 | | |
| 4549 | hypothetical protein LOC100216834 | 1.453725316 |
| GRMZM2G09 | | |
| 0904 | 26S proteasome regulatory complex ATPase RPT3 | 2.965538499 |
| GRMZM2G09 | | |
| 2975 | hypothetical protein LOC100274112 | 1.486541189 |
| GRMZM2G09 | | |
| 3557 | LOC100282612 | 2.06781691 |
| GRMZM2G10 | | |
| 4373 | hypothetical protein LOC100279843 | 1.536703863 |

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| | GRMZM2G10 | | |
| | 7362 | hypothetical protein LOC100274445 | 1.37019128 |
| | GRMZM2G11 | | |
| | 7544 | hypothetical protein LOC100272320 | -1.33896769 |
| | GRMZM2G12 | | |
| | 0047 | hypothetical protein LOC100191947 | -1.194851794 |
| | GRMZM2G12 | | |
| | 6956 | Hypothetical protein LOC100381699 | 3.118401308 |
| | GRMZM2G13 | | |
| | 7528 | hypothetical protein LOC100273032 | 1.232207167 |
| | GRMZM2G14 | | |
| | 0867 | LOC100283485 | 1.251489804 |
| | GRMZM2G17 | | |
| | 1604 | 26S protease regulatory subunit S10B | 1.84319397 |
| | GRMZM2G18 | | |
| | 1359 | hypothetical protein LOC100272769 | 1.284047597 |
| | GRMZM2G36 | | |
| | 8908 | hypothetical protein LOC100276453 | -1.037787704 |
| | GRMZM2G40 | | |
| | 2002 | hypothetical protein LOC100279448 | 1.429530823 |
| | GRMZM2G46 | | |
| | 7059 | 26S proteasome non-ATPase regulatory subunit 14 | 1.463241688 |
| | AC149475.2_F | | |
| 26S proteasome | G003 | proteasome subunit alpha type 5 | 1.962609336 |
| | GRMZM2G00 | | |
| | 5080 | hypothetical protein LOC100193140 | -1.86821455 |
| | GRMZM2G01 | | |
| | 6511 | maize 20S proteasome alpha subunit | 1.612211793 |
| | GRMZM2G02 | | |
| | 7282 | 26S protease regulatory subunit 6A | 1.047923343 |
| | GRMZM2G02 | | |
| | 9583 | 26S proteasome non-ATPase regulatory subunit 6 | 1.928302012 |
| | GRMZM2G03 | 26S proteasome non-ATPase regulatory subunit 14 | 1.586790527 |

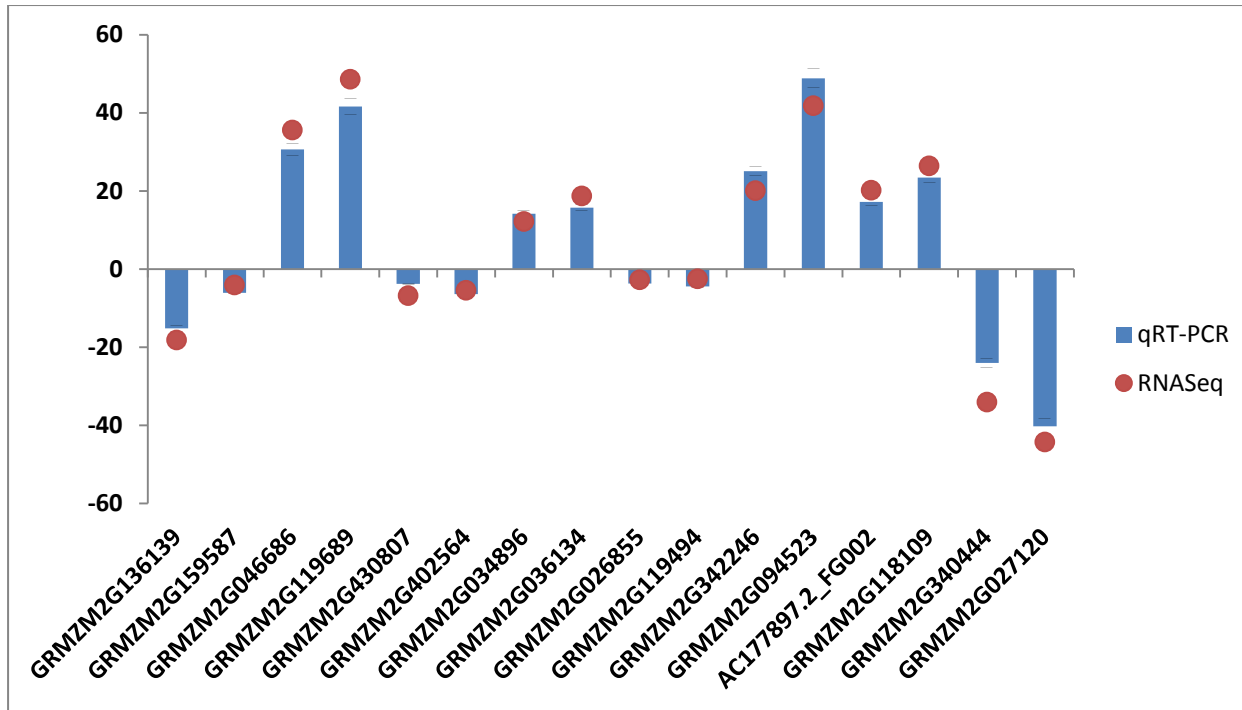
| | | |
|-----------|---|--------------|
| 3626 | | |
| GRMZM2G03 | | |
| 8126 | 26S proteasome regulatory complex ATPase RPT3 | 1.109210759 |
| GRMZM2G05 | | |
| 6569 | Uncharacterized protein | 1.042449792 |
| GRMZM2G05 | | |
| 6870 | proteasome subunit alpha type 5 | 2.695589283 |
| GRMZM2G06 | | |
| 1745 | hypothetical protein LOC100274928 | 1.119071132 |
| GRMZM2G07 | | |
| 4037 | Putative uncharacterized protein | 1.247360523 |
| GRMZM2G07 | | |
| 4549 | hypothetical protein LOC100216834 | 1.453725316 |
| GRMZM2G09 | | |
| 0904 | 26S proteasome regulatory complex ATPase RPT3 | 2.965538499 |
| GRMZM2G09 | | |
| 2975 | hypothetical protein LOC100274112 | 1.486541189 |
| GRMZM2G09 | | |
| 3557 | 26S proteasome non-ATPase regulatory subunit 6 Putative uncharacterized protein | 2.06781691 |
| GRMZM2G10 | | |
| 4373 | 26S protease regulatory subunit 4 | 1.536703863 |
| GRMZM2G10 | | |
| 7362 | 26S protease regulatory subunit 8 Putative uncharacterized protein | 1.37019128 |
| GRMZM2G11 | | |
| 7544 | hypothetical protein LOC100272320 | -1.33896769 |
| GRMZM2G12 | | |
| 0047 | proteasome core complex, alpha-subunit complex | -1.194851794 |
| GRMZM2G13 | | |
| 7528 | hypothetical protein LOC100273032 | 1.232207167 |
| GRMZM2G14 | | |
| 0867 | LOC100283485 | 1.251489804 |
| GRMZM2G17 | | |
| 1604 | 26S protease regulatory subunit S10B | 1.84319397 |

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|-------------------------|-----------|---|--------------|
| | GRMZM2G18 | | |
| | 1359 | hypothetical protein LOC100272769 | 1.284047597 |
| | GRMZM2G36 | | |
| | 8908 | hypothetical protein LOC100276453 | -1.037787704 |
| | GRMZM2G46 | | |
| | 7059 | 26S proteasome non-ATPase regulatory subunit 14 | 1.463241688 |
| Plant cysteine oxidases | GRMZM2G03 | | |
| | 8677 | hypothetical protein LOC100193573 | 9.957920143 |
| | GRMZM2G04 | | |
| | 3417 | unknown | 4.695945499 |
| | GRMZM2G10 | | |
| | 7557 | Putative uncharacterized protein | 18.408279 |
| | GRMZM2G11 | | |
| | 3355 | hypothetical protein LOC100191278 | 2.308400175 |
| | GRMZM2G13 | | |
| | 6250 | hypothetical protein LOC100191514 | 1.21591446 |
| | GRMZM2G16 | | |
| | 2175 | Cupin, RmlC-type Putative uncharacterized protein | 1.935559433 |

Table S8. Primer sequences of waterlogging responsive genes identified in various pathways in RNASeq for qRT-PCR validation

| Gene ID | Annotation | Primer | Primer sequence | Tm | Length | GC % | Amplicon length |
|---------------|---|--------|------------------------|----|--------|------|-----------------|
| GRMZM2G136139 | Neutral/alkaline invertase | F | ACCCGAGTTCTGGTTCTTTG | 62 | 20 | 50 | 87 |
| | | R | AACATTGGACACGCCTACTT | 62 | 20 | 45 | |
| GRMZM2G159587 | Glyoxylate reductase | F | CCAAGTCCAACCTCCCTAAAC | 62 | 21 | 52.4 | 116 |
| | | R | CCAAGTCCAACCTCCCTAAAC | 62 | 21 | 52.4 | |
| GRMZM2G046686 | Hexokinase-1 | F | CGGTCTCTACCAAGGCTATTC | 61 | 21 | 52.4 | 111 |
| | | R | CGGTCTCTACCAAGGCTATTC | 61 | 22 | 50 | |
| GRMZM2G119689 | Beta-fructofuranosidase, insoluble isoenzyme 2 | F | CGTGTTCCTCAGGGTGTTC | 62 | 20 | 50 | 137 |
| | | R | AGATGTCCGTGTGACAAATC | 62 | 21 | 47.6 | |
| GRMZM2G430807 | metallothionein-like protein type 2 | F | CAGCAAAGCCCTGTAGTGATA | 62 | 21 | 47.6 | 108 |
| | | R | AAGAGCTCTCTACTCTCTCTC | 62 | 22 | 50 | |
| GRMZM2G402564 | Metallothionein2 | F | CTAGTGGAGGGAGTTGTCTAGT | 62 | 22 | 50 | 121 |
| | | R | ACGATACCACGATGCAGATG | 62 | 20 | 50 | |
| GRMZM2G034896 | hypothetical protein LOC100384248 | F | CACAGACACAGTTGGGAAAGA | 62 | 21 | 47.6 | 103 |
| | | R | CCAACTTTCGCAGTCACAAAC | 62 | 21 | 47.6 | |
| GRMZM2G036134 | hypothetical protein LOC100191400 | F | CTTTCGCAGACCAAGGACAT | 62 | 20 | 50 | 84 |
| | | R | GAGCGTTCAGAGAAGTTGAG | 62 | 21 | 52.4 | |
| GRMZM2G026855 | hypothetical protein LOC100273291 | F | GGGTTTCATCCAGAGCGATTAC | 62 | 21 | 52.4 | 104 |
| | | R | ACGCTCATGTCTCCACATAC | 62 | 21 | 47.6 | |
| GRMZM2G119494 | Glycoside hydrolase, family 28 Putative uncharacterized protein | F | ACCATGAAGTGGGTGTTCTG | 62 | 20 | 50 | 109 |
| | | R | ACACGTCGCTGTAGTTGATG | 62 | 20 | 50 | |
| GRMZM2G342246 | product:beta-expansin 7 | F | CGTTCCTTCGATTCACTTCCT | 62 | 21 | 47.6 | 102 |
| | | R | TTAGTAGGCCGACAGGAGAA | 62 | 20 | 50 | |
| GRMZM2G094523 | Putative uncharacterized protein | F | GCGTTCATCGACATCTCTAAT | 62 | 22 | 45.5 | 122 |

| | | | | | | | |
|------------------|--|---|------------------------|----|----|------|-----|
| | | R | TGTGAACTGGTAAAGAGCAGAA | 62 | 22 | 40.9 | |
| AC177897.2_FG002 | hypothetical protein LOC100274874 | F | GAGCACAGCCACTACTAACAA | 62 | 21 | 47.6 | 102 |
| | | R | GCGCATAAGGGTTGAACAAAG | 62 | 21 | 47.6 | |
| GRMZM2G118109 | hypothetical protein LOC100194002 | F | CTGAGGTGAGGTGTTTCCTAAA | 62 | 22 | 45.4 | 98 |
| | | R | TGAGAGTCGTTGCCTCTACTA | 62 | 21 | 47.6 | |
| | Putative RING zinc finger domain superfamily protein | F | TAACCAGCTCAGCGCTATTG | 62 | 20 | 50 | 103 |
| GRMZM2G340444 | | R | TGAGGAAAGCGGAAGAAAGG | 62 | 20 | 50 | |
| | protein binding protein (LOC100283571), mRNA | F | GGGAGAATGCATGTTCTGACT | 62 | 21 | 47.6 | 97 |
| GRMZM2G027120 | | R | CAGCCAAAGGACGCAAATAAG | 62 | 21 | 47.6 | |



Supplementary Figure S1: Validation of selected genes operating in different pathways expressed in RNAseq by qRT-PCR. X-axis represents the gene models and Y-axis represents the log-transformed fold change expression values of genes. Error bar in the column represents the standard error.