**Table S1 Primers for qRT-PCR**

|  |  |
| --- | --- |
| **Gene name** | **Sequence** |
| *ACTIN* | F：GCCAACAGGGAGAAGATGACA |
| R：CATAGATTGGGACTGTGTGACTGAC |
| *SOD* | F：CAGGACCCTCTTGTGACCAAAG |
| R：CCAGTTCACCACCTTCCAGATG |
| *POD* | F：ACTTCCACGACTGCTTTGTCCA |
| R：CATATACTCTCCAGCTGGGTCTTG |
| *CHS* | F：AAGATCACCAAGAGCGACCACAT |
| R：AGGATCTCCTCHGTNAGGTGC |
| *CHI* | F: CGGCGAGTTCGAGAAGTTCAC |
| R: TTCCAGTAGGCGACGCAGTT |
| *APX* | F: CGTTCGGGACGATGAAGAAG |
| R: CTCCCGCAAGCTGGTAGAGATC |
| *GR* | F: AAGCTGTTGGTGTTGAGGTTGA |
| R: CGAAGCAAGTAGCCTCCATCAGA |

**Table S2 Oxidation-responsive related genes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Gene ID** | **CK** | **T1** | **T2** | **T3** | **Short description** |
| 543249 | 40.13786317 | 44.0209672 | 22.25187816 | 36.534133 | Superoxide dismutase [Mn] |
| 543248 | 37.12333072 | 32.84838815 | 22.37176889 | 29.10087683 | Superoxide dismutase [Cu-Zn] |
| 123168517 | 33.62378 | 51.22033168 | 84.87019553 | 97.3588603 | Catalase |
| 542902 | 29.90415603 | 41.76387699 | 54.98014284 | 63.06623027 | Catalase |
| 100192163 | 107.5116424 | 168.5575506 | 211.3317084 | 357.9801123 | Peroxidase-like |
| 123172175 | 127.4441958 | 140.1125431 | 3.110525995 | 49.25207121 | Peroxidase 1-like |
| 100415849 | 103.61967 | 112.5087638 | 2.134449297 | 44.86771962 | Peroxidase 1-like |
| 123095258 | 84.35280982 | 99.71071042 | 1.038634721 | 30.17783126 | Peroxidase 1-like |
| 123166621 | 65.03809989 | 64.33522073 | 1.449325569 | 22.7970285 | Peroxidase 1-like |
| 123162197 | 45.58821281 | 52.66598367 | 2.476653649 | 18.36673464 | Peroxidase 1-like |
| 123089493 | 41.40916028 | 42.05011741 | 0.979123728 | 22.11128084 | Peroxidase 1-like |
| 123095242 | 39.40148236 | 44.46792948 | 0.951046814 | 19.70272741 | Peroxidase 1-like |
| 123169875 | 35.5429389 | 46.0496483 | 1.94285424 | 18.51415874 | Peroxidase 1-like |
| 123138488 | 32.00355871 | 38.01621296 | 0.753775347 | 21.81136943 | Peroxidase 1-like |
| 123153158 | 31.98623643 | 34.19044857 | 1.308647446 | 16.20093481 | Peroxidase 1-like |
| 123069666 | 27.62002882 | 27.84418486 | 7.233411824 | 11.5644687 | Peroxidase 1-like |
| 123165861 | 28.3813015 | 29.68551113 | 1.06887576 | 12.69502472 | Peroxidase 1-like |
| 123152087 | 20.25322911 | 23.11982157 | 5.921979905 | 17.71049229 | Peroxidase 1-like |
| 123065150 | 23.18770191 | 19.2216519 | 4.464077014 | 12.75599993 | Peroxidase 1-like |
| 123175516 | 17.78215025 | 19.22627259 | 3.291176992 | 14.78789629 | Peroxidase 1-like |
| 123172065 | 18.76122265 | 19.84396027 | 0.409316424 | 11.07372286 | Peroxidase 1-like |
| 123173851 | 9.459622189 | 15.07705772 | 1.502842123 | 14.88731157 | Peroxidase 1-like |
| 123186045 | 8.918099125 | 8.920626116 | 3.130713709 | 19.31549182 | Peroxidase 1-like |
| 123161047 | 11.74586525 | 10.52861324 | 1.863585846 | 6.120846648 | Peroxidase 1-like |
| 123169245 | 9.180547282 | 10.20596018 | 1.527405738 | 8.424091267 | Peroxidase 1-like |
| 123064711 | 11.85433869 | 15.41895203 | 0.460079077 | 11.88946604 | Peroxidase 1-like |
| 123172143 | 13.56040818 | 15.09769486 | 0.306465639 | 6.435007317 | Peroxidase 1-like |
| 123151592 | 9.771786434 | 14.66533095 | 1.142845499 | 9.3173878 | Peroxidase 1-like |
| 123168167 | 7.757632478 | 9.92864876 | 1.141185669 | 6.443342764 | Peroxidase 1-like |
| 123169347 | 7.269664036 | 9.261701755 | 1.032895449 | 6.534601843 | Peroxidase 1-like |
| 123161813 | 6.38130211 | 9.26118914 | 1.332977178 | 6.869123784 | Peroxidase 1-like |
| 123074288 | 7.573307831 | 6.468809726 | 1.676447662 | 5.376958761 | Peroxidase 1-like |
| 123052973 | 6.418770008 | 7.152560487 | 0.682230572 | 5.312946875 | Peroxidase 1-like |
| 123151335 | 4.826419938 | 6.934720915 | 1.887798845 | 4.825788505 | Peroxidase 1-like |
| 123138504 | 5.889443641 | 4.164425824 | 0.781614329 | 5.165184513 | Peroxidase 1-like |
| 123169075 | 2.972252032 | 3.286856934 | 0.401119313 | 4.350126924 | Peroxidase 1-like |
| 123174155 | 2.662458313 | 3.8067657 | 1.005989028 | 3.081535345 | Peroxidase 1-like |
| 123161259 | 3.199654344 | 4.499347748 | 0.852631516 | 1.915620667 | Peroxidase 1-like |
| 123061385 | 3.063644083 | 3.304237141 | 0.596626493 | 2.670266535 | Peroxidase 1-like |
| 123168741 | 2.905228156 | 1.63958952 | 0.832761888 | 3.122612437 | Peroxidase 1-like |
| 123058134 | 3.642074571 | 2.948051751 | 0.19412764 | 1.477423816 | Peroxidase 1-like |
| 123045148 | 0.751008001 | 0.301372653 | 1.996322148 | 2.52208872 | Peroxidase 1-like |
| 123172114 | 1.775654923 | 2.110027591 | 0.073086676 | 0.670967437 | Peroxidase 1-like |
| 123054680 | 1.141685295 | 1.152916757 | 0.576923779 | 1.279840953 | Peroxidase 1-like |
| 123190528 | 1.090954458 | 1.0177148 | 0.442161609 | 1.330639491 | Peroxidase 1-like |
| 123169869 | 533.2291787 | 769.7312873 | 71.51024378 | 420.7731614 | Peroxidase 2-like |
| 123149179 | 424.2971813 | 575.5433468 | 40.72001189 | 342.5194495 | Peroxidase 2-like |
| 123159438 | 126.0453736 | 183.6595259 | 23.23837758 | 111.8382505 | Peroxidase 2-like |
| 123164003 | 124.7867843 | 151.0101086 | 5.17985553 | 70.38208758 | Peroxidase 2-like |
| 123040632 | 78.98419784 | 108.2063489 | 10.63176981 | 97.19421093 | Peroxidase 2-like |
| 123190266 | 77.19119702 | 74.45315101 | 42.01186212 | 96.1109596 | Peroxidase 2-like |
| 123152298 | 72.32984459 | 118.9739681 | 3.837377514 | 65.99382384 | Peroxidase 2-like |
| 123048911 | 101.2838764 | 111.453492 | 8.487839883 | 53.43604711 | Peroxidase 2-like |
| 123134895 | 66.03768578 | 97.51465317 | 2.494733489 | 35.81214768 | Peroxidase 2-like |
| 123161527 | 54.63282561 | 94.869227 | 2.054730189 | 42.39949016 | Peroxidase 2-like |
| 123184901 | 72.16039521 | 76.59631775 | 2.968416987 | 38.81387346 | Peroxidase 2-like |
| 123065726 | 49.86629339 | 67.73746529 | 10.9200191 | 36.859186 | Peroxidase 2-like |
| 123040904 | 65.25475005 | 61.64660167 | 5.195485286 | 26.25331412 | Peroxidase 2-like |
| 123044039 | 53.72739704 | 56.09713832 | 2.375286925 | 24.49507607 | Peroxidase 2-like |
| 123048914 | 41.34272875 | 47.96052258 | 6.560923972 | 21.42097056 | Peroxidase 2-like |
| 123172224 | 38.49208528 | 46.9462064 | 1.546614955 | 24.40391199 | Peroxidase 2-like |
| 123141847 | 41.24169932 | 54.67841323 | 0.454161107 | 12.78453398 | Peroxidase 2-like |
| 123048924 | 16.07359927 | 31.6099362 | 3.657462231 | 21.64533794 | Peroxidase 2-like |
| 123184903 | 21.94102888 | 32.37015479 | 1.878110303 | 10.82707276 | Peroxidase 2-like |
| 123048913 | 23.5796223 | 28.31715844 | 3.241865142 | 11.27665204 | Peroxidase 2-like |
| 123161762 | 16.28304726 | 25.92742924 | 1.060929803 | 17.68871323 | Peroxidase 2-like |
| 123142074 | 17.12075849 | 21.8727397 | 0.744325449 | 9.401787394 | Peroxidase 2-like |
| 123074809 | 12.62115479 | 16.94318379 | 2.901280249 | 8.257856982 | Peroxidase 2-like |
| 123048923 | 7.042821263 | 13.76010815 | 0.651723379 | 8.813822036 | Peroxidase 2-like |
| 123133427 | 4.617657708 | 2.052328919 | 7.369027479 | 15.6844602 | Peroxidase 2-like |
| 123074811 | 7.564143561 | 12.86707189 | 1.779966917 | 5.596662639 | Peroxidase 2-like |
| 123042911 | 8.243209136 | 7.162133283 | 1.067833254 | 5.045859706 | Peroxidase 2-like |
| 123131237 | 6.850819909 | 9.21586138 | 0.275725848 | 3.163657943 | Peroxidase 2-like |
| 123167912 | 5.353816145 | 5.640113318 | 0.890923937 | 5.753590041 | Peroxidase 2-like |
| 123177879 | 1.348739608 | 0.762734618 | 1.656749656 | 10.55133903 | Peroxidase 2-like |
| 123048916 | 2.95423484 | 5.020911027 | 1.299379218 | 3.993762917 | Peroxidase 2-like |
| 123184906 | 0.876499581 | 2.836459871 | 0.477624629 | 1.487129167 | Peroxidase 2-like |
| 123120361 | 26.43352885 | 21.62356113 | 11.54435777 | 20.98061075 | Peroxidase 4-like |
| 123103175 | 9.042582517 | 7.524618764 | 5.484567009 | 9.405442876 | Peroxidase 4-like |
| 123111371 | 12.35145491 | 7.932326851 | 6.429351425 | 14.13933091 | Peroxidase 4-like |
| 123168526 | 42.5622625 | 39.48023569 | 5.79188115 | 16.83495779 | Peroxidase 5-like |
| 123165402 | 38.33771897 | 54.78847844 | 4.694492185 | 27.93156652 | Peroxidase 5-like |
| 123094147 | 64.86225471 | 80.57201181 | 8.745124801 | 43.25643687 | Peroxidase 5-like |
| 123128978 | 29.35746938 | 24.01313196 | 2.01633756 | 12.286372 | Peroxidase 5-like |
| 123127034 | 18.44352026 | 14.72135084 | 3.041200456 | 8.137335799 | Peroxidase 5-like |
| 123170058 | 6.708431219 | 6.351776797 | 0.840103613 | 3.372262825 | Peroxidase 5-like |
| 123087641 | 5.319899344 | 5.201141419 | 0.53610263 | 3.301436637 | Peroxidase 5-like |
| 123069609 | 11.99005331 | 13.71419268 | 4.534434613 | 14.57777345 | Peroxidase 9-like |
| 100136988 | 306.9190913 | 287.7686411 | 490.8552638 | 323.2916766 | Peroxidase 12 |
| 100136987 | 192.9544146 | 168.2343065 | 417.9263404 | 209.1923465 | Peroxidase 12 |
| 123076867 | 277.1542373 | 201.3354642 | 37.48841517 | 130.1680748 | Peroxidase 12-like |
| 123068315 | 148.9302062 | 115.4512837 | 23.10140076 | 81.10923753 | Peroxidase 12-like |
| 123042901 | 192.2816015 | 164.396042 | 22.19239288 | 92.00869194 | Peroxidase 12-like |
| 123186686 | 66.01945303 | 50.98658025 | 18.40903156 | 44.9896854 | Peroxidase 12-like |
| 123047544 | 45.57827839 | 41.50642696 | 4.601408829 | 18.90352022 | Peroxidase 12-like |
| 123186690 | 4.318962425 | 7.095084098 | 14.97294732 | 27.20951669 | Peroxidase 12-like |
| 123078101 | 73.04348617 | 93.62171499 | 35.44778545 | 148.6069439 | Peroxidase 15-like |
| 123069619 | 67.5351309 | 77.18287815 | 33.08603059 | 102.6713664 | Peroxidase 15-like |
| 123061031 | 45.81882597 | 52.89085674 | 29.06411369 | 89.89876263 | Peroxidase 15-like |
| 123148753 | 3.744121209 | 4.271192255 | 6.819942885 | 1.913354113 | Peroxidase 16-like |
| 123078760 | 10.80386854 | 8.36548678 | 1.759172751 | 5.685055501 | Peroxidase 19-like |
| 123070309 | 6.278271772 | 5.541348909 | 1.332902472 | 3.966817599 | Peroxidase 19-like |
| 123042913 | 12.94724354 | 14.58062683 | 0.613869352 | 5.125444606 | Peroxidase 31-like |
| 123055352 | 20.76929697 | 18.61911682 | 0.579734675 | 7.911854094 | Peroxidase 31-like |
| 123113412 | 44.58999974 | 41.37498119 | 7.704976757 | 22.20325993 | Peroxidase 35-like |
| 123122929 | 36.13411271 | 29.8520984 | 6.996019353 | 13.58349834 | Peroxidase 35-like |
| 123105121 | 29.36802425 | 27.9792711 | 6.899417969 | 16.6752085 | Peroxidase 35-like |
| 123180799 | 28.60258412 | 25.57524911 | 10.73469414 | 20.60411889 | Peroxidase 42-like |
| 123115454 | 2.003233161 | 0.655443522 | 0.336604627 | 1.071597196 | Peroxidase 42-like |
| 123041590 | 13.05369442 | 9.997300625 | 1.142546744 | 6.123859342 | Peroxidase 43-like |
| 123185674 | 7.255954616 | 6.899699189 | 1.555504592 | 3.06656557 | Peroxidase 43-like |
| 123049562 | 5.058709677 | 3.88102583 | 0.315522052 | 2.366407221 | Peroxidase 43-like |
| 123189671 | 1.340211885 | 1.927113389 | 0.592040499 | 0.682166767 | Peroxidase 46-like |
| 123078099 | 158.8966087 | 182.584791 | 69.87357911 | 156.1507429 | Peroxidase 49-like |
| 123069615 | 97.15714939 | 102.9824303 | 41.1239848 | 90.00274364 | Peroxidase 49-like |
| 123152420 | 22.22888123 | 24.96849694 | 1.804918445 | 12.36388385 | Peroxidase 55-like |
| 123162898 | 17.81496638 | 20.43816622 | 3.26899043 | 9.163001624 | Peroxidase 55-like |
| 123166586 | 15.01024325 | 17.45011821 | 2.678227988 | 7.914461023 | Peroxidase 55-like |
| 123104317 | 14.45081112 | 13.5889209 | 4.065744929 | 9.333843154 | Peroxidase 55-like |
| 123122082 | 12.4819095 | 12.52410054 | 3.920011903 | 7.689597196 | Peroxidase 55-like |
| 123094846 | 11.59306821 | 10.40010962 | 3.002928731 | 7.569232415 | Peroxidase 56-like |
| 123134784 | 18.06013169 | 19.14991547 | 1.710844158 | 14.25756151 | Peroxidase 57-like |
| 123091943 | 8.341961557 | 8.508050095 | 0.943379201 | 5.968393192 | Peroxidase 57-like |
| 123168956 | 7.022319734 | 8.76708473 | 0.839356954 | 5.109240953 | Peroxidase 57-like |
| 123186125 | 39.9718644 | 37.05024776 | 0.835042809 | 10.53748112 | Peroxidase 64-like |
| 123054627 | 18.22817986 | 15.31334544 | 0.461066403 | 5.963980172 | Peroxidase 64-like |
| 123154588 | 51.81982994 | 81.95474975 | 23.20033171 | 79.65030787 | Peroxidase 70-like |
| 123081903 | 6.70283598 | 9.207831515 | 1.869669393 | 4.405368514 | Peroxidase 70-like |
| 123051570 | 2.677390903 | 2.965106477 | 0.716340232 | 7.927906574 | Peroxidase 70-like |
| 123061026 | 120.1008701 | 126.2131116 | 53.38246395 | 151.4830845 | Peroxidase 72-like |
| 123049390 | 67.8165984 | 71.68083961 | 22.74681025 | 79.02481783 | Peroxidase 72-like |
| 123078097 | 49.3508817 | 52.11071717 | 34.88996212 | 72.76930288 | Peroxidase 72-like |
| 123138218 | 63.43305999 | 57.92871279 | 10.46959317 | 24.82138963 | Peroxidase 72-like |
| 123185487 | 34.15700252 | 37.77873538 | 7.532216723 | 41.83160956 | Peroxidase 72-like |
| 123069613 | 29.11299704 | 33.14320228 | 15.50827521 | 43.33401175 | Peroxidase 72-like |
| 123041399 | 33.14323526 | 34.88315978 | 9.922812483 | 31.60369893 | Peroxidase 72-like |
| 123145482 | 36.68310451 | 28.9543079 | 3.556608754 | 12.4190012 | Peroxidase 72-like |
| 123128366 | 12.56789758 | 11.85680033 | 6.333268573 | 9.623527633 | Peroxidase 72-like |
| 123191163 | 108.8579565 | 75.44194794 | 14.34329571 | 56.17092943 | Cationic peroxidase SPC4-like |
| 123186699 | 42.1984071 | 35.17644705 | 1.023887498 | 18.75853299 | Cationic peroxidase SPC4-like |
| 123042893 | 32.46947569 | 31.00729196 | 0.625159694 | 12.05845793 | Cationic peroxidase SPC4-like |

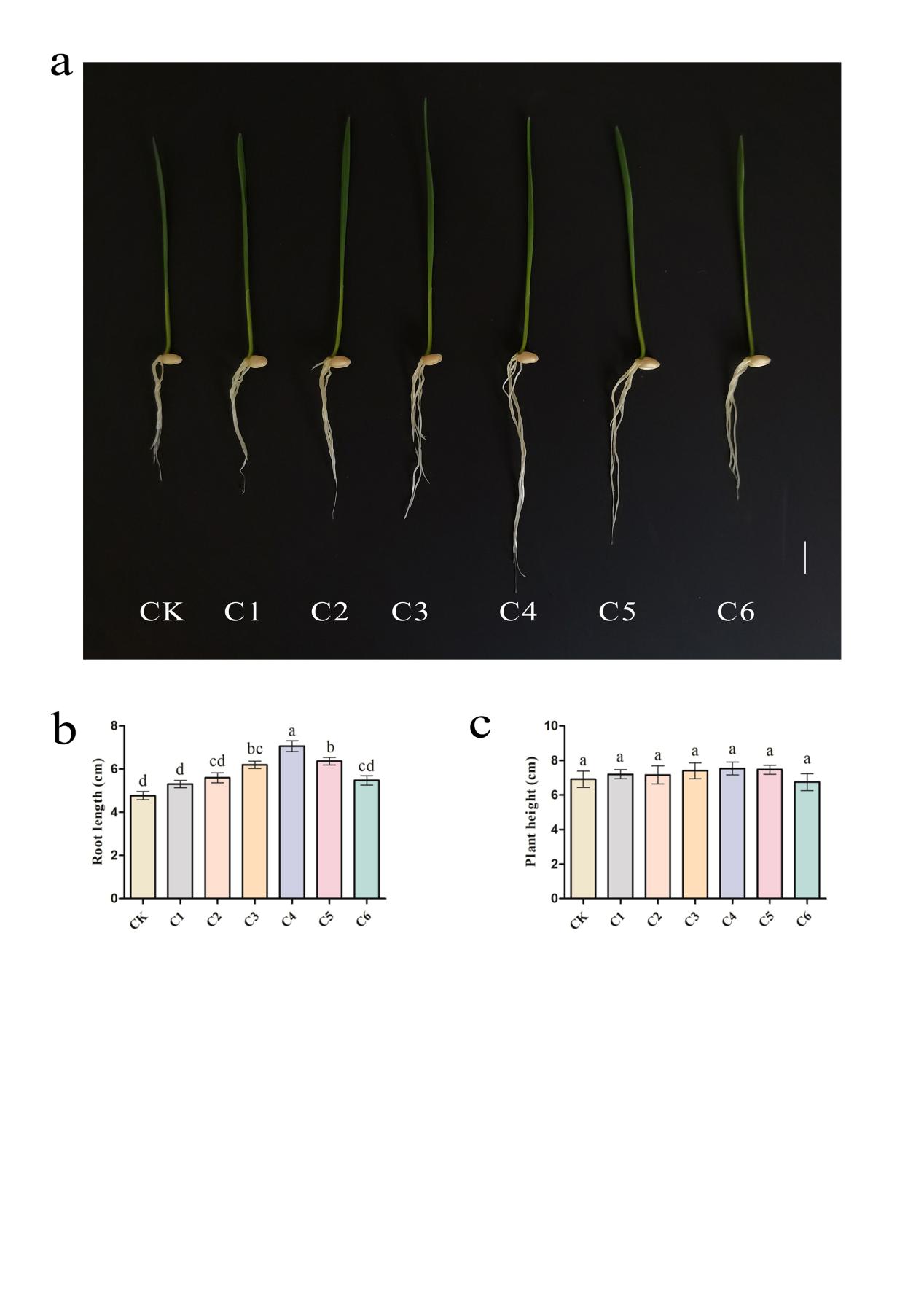


Figure S1. Effects of different concentrations of CeO2-NPs treatments(CK：0 mg/L, C1:20 mg/L, C2:60 mg/L, C3:100 mg/L, C4:120 mg/L, C5:140 mg/L and C6:160 mg/L) on wheat growth:(a) phenotypic images, (b) root length, (c)plant height.Different letters represent significant differences (*P<0.05*). Scale bar: 1 cm.

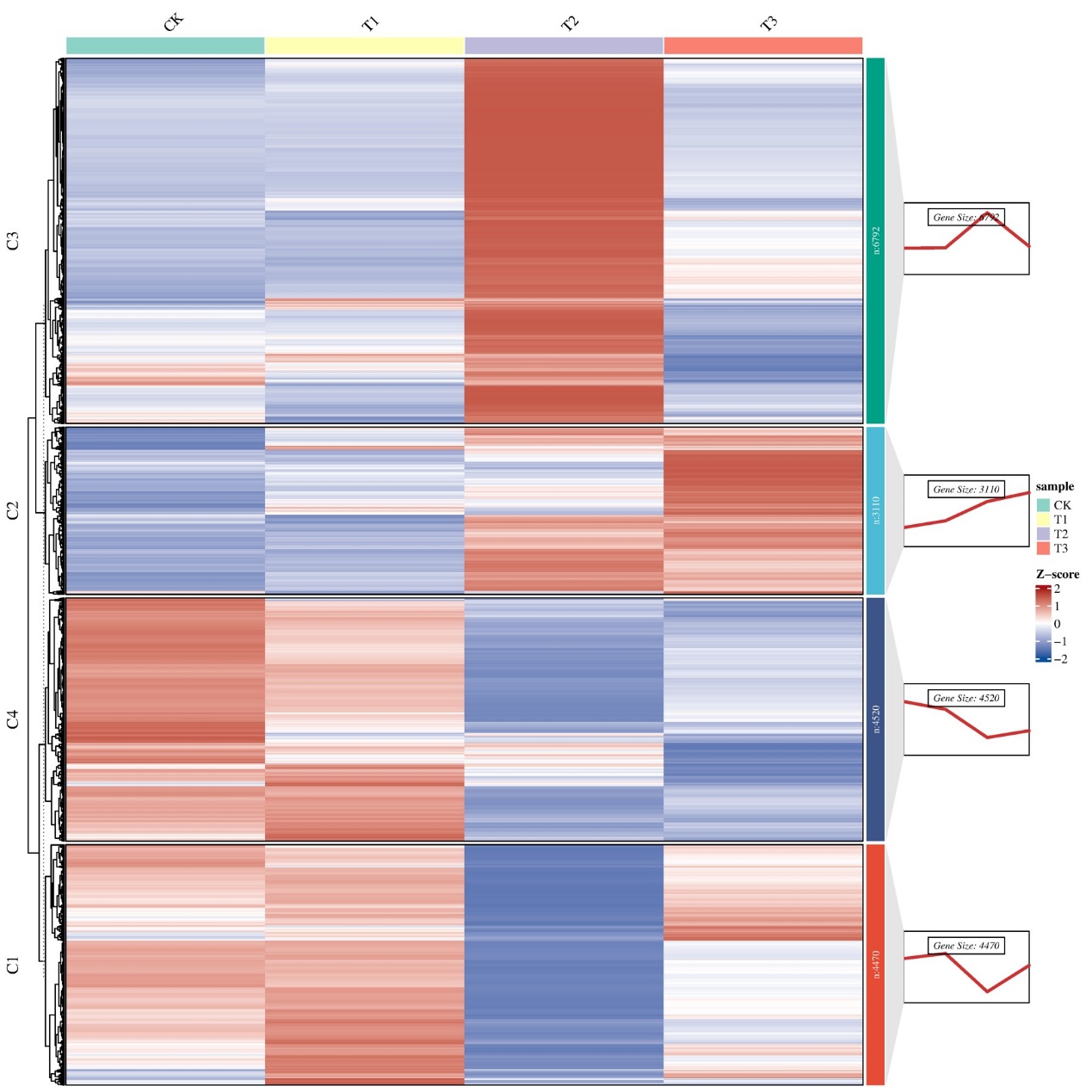


Figure S2. Clustering heatmap of wheat under all treatments. The DEGs were clustered into four groups (C1, C2, C3, C4) based on expression trends. CK, T1, T2, and T3 denote the CK, CeO2-NPs, UV-B, and UV-B+CeO2-NPs groups, respectively.