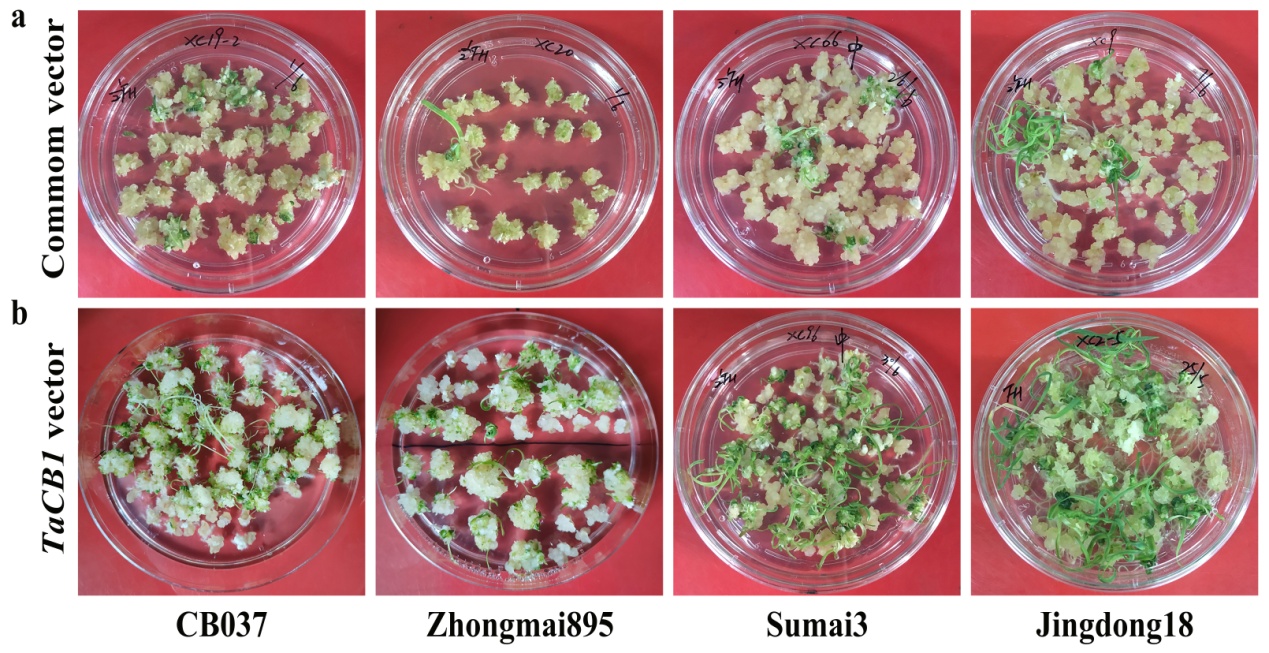


**Extended data Fig. 1** Phylogenetic relationships among TaCB1 and TaCB2 proteins from wheat, and WOX proteins from *Arabidopsis.*

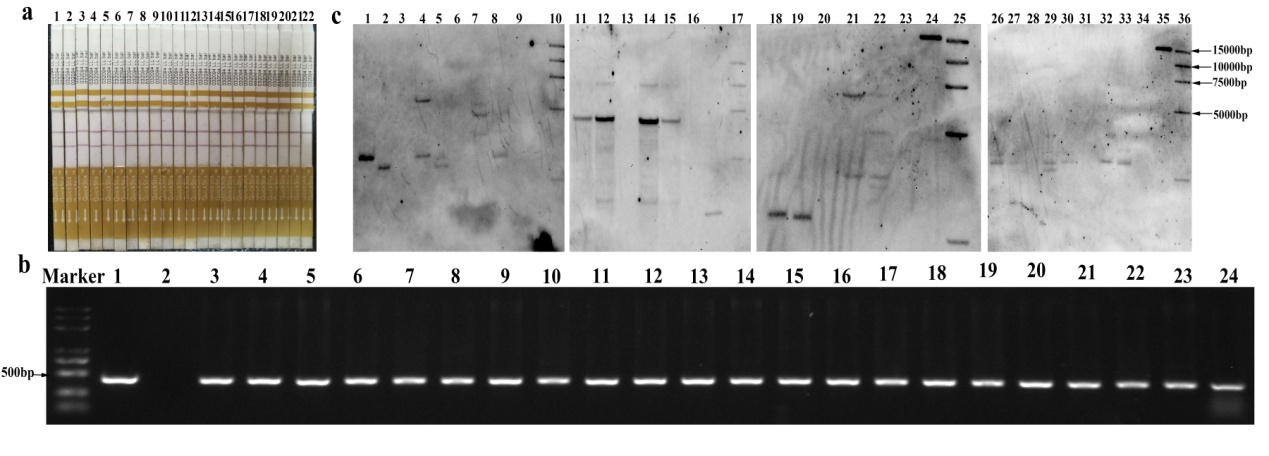
Phylogenetic tree was constructed based on the sequences of TaCB1 and TaCB2 proteins in wheat and WOX proteins in *Arabidopsis* by the MEGA X using the neighbor-joining approach with 1000 bootstrap replicates. Scale plate and legend in left displayed tree scale and bootstrap value.

AtWUS: NP\_565429; AtWOX1: NP\_188428; AtWOX2: NP\_200742; AtWOX3: NP\_180429; AtWOX4: NP\_175145; AtWOX5: NP\_187735; AtWOX6: NP\_565263; AtWOX7: NP\_196196; AtWOX8: NP\_199410; AtWOX9: NP\_180944; AtWOX10: NP\_173494; AtWOX11: NP\_187016; AtWOX12: NP\_197283; AtWOX13: NP\_195280; AtWOX14: NP\_173493. TaCB1: MN412513; TaWUS-A: MW452946; TaWUS-B: MW452947; TaWUS-A: MW452945.



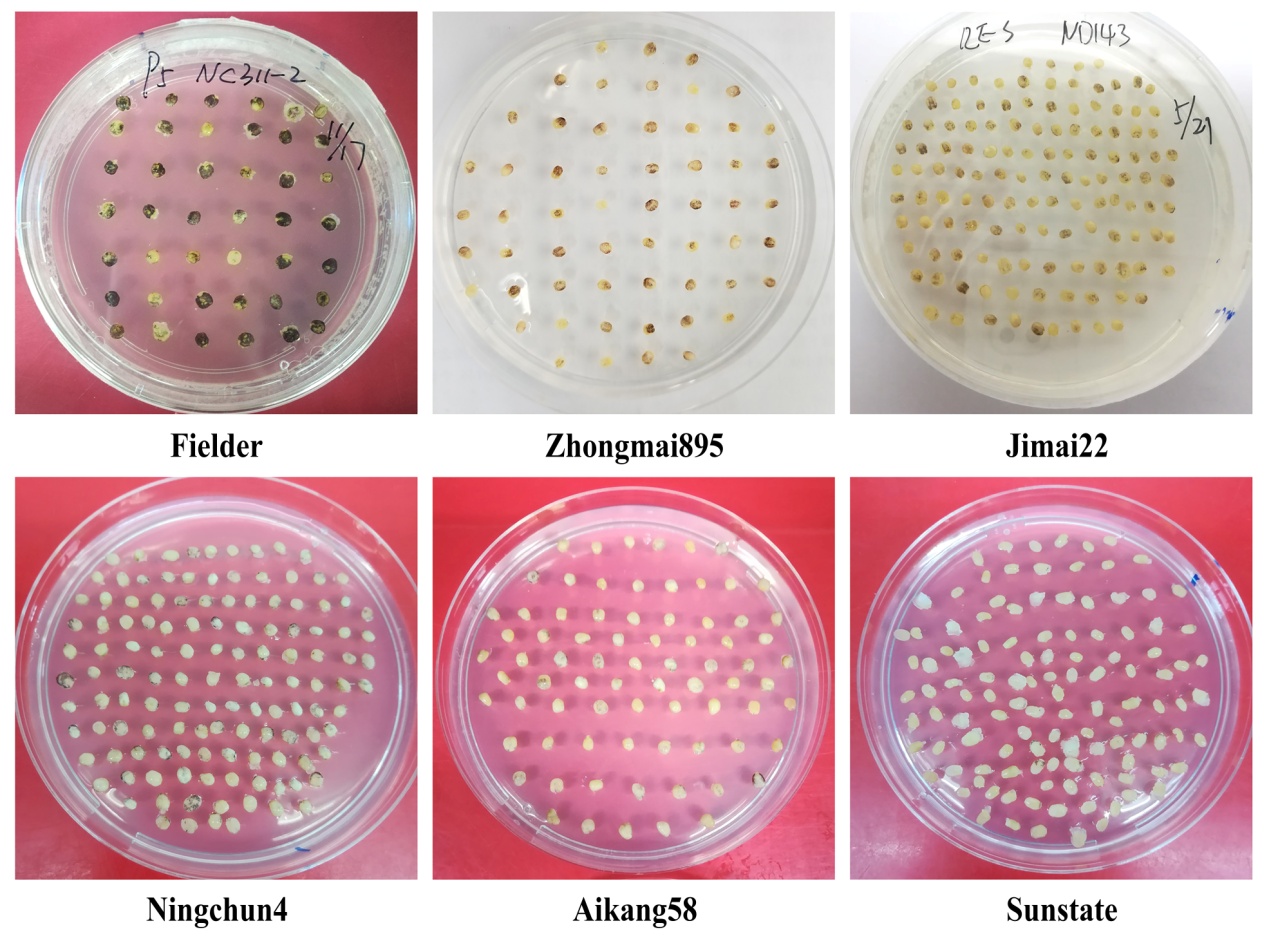
**Extended data Fig. 2** Shoot regeneration of the immature embryos of different wheat genotypes promoted by the *TaCB1* gene.

a: Shoot regeneration of the wheat embryos transformed with common vectors. b: Shoot regeneration of the wheat embryos transformed with *TaCB1* gene containing vector.

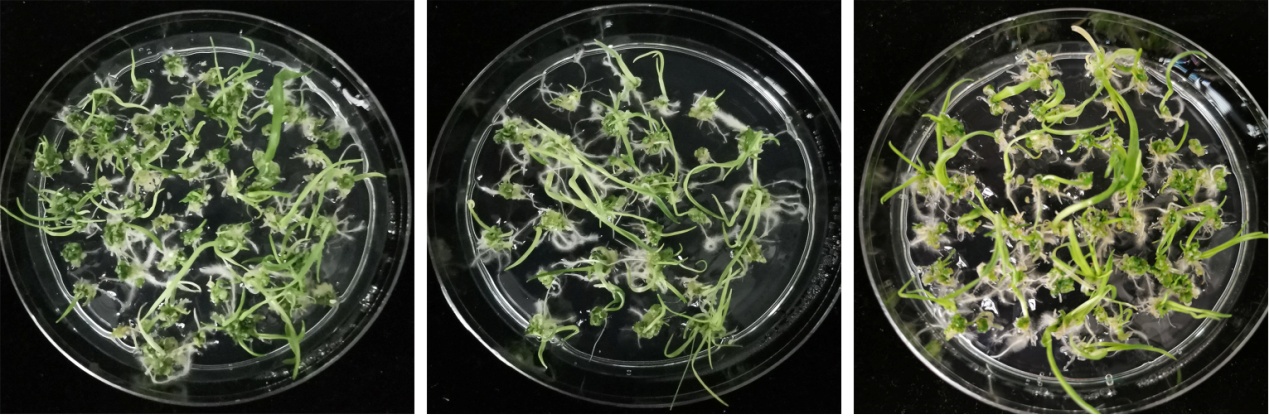


**Extended data Fig. 3.** Detection of transgenic wheat plants by QuickStix Kit, PCR and Southern blot.

a: QuickStix Kit assay for the Bar protein; 1-21: transgenic plants; 22: the wild-type Fielder. b: PCR detection for *Bar* gene; 1: plasmid of *TaCB1* vector; 2: the wild-type Fielder; 3-24: transgenic plants. c: Southern blot assay for *Bar* gene; 1-2: transgenic plants of Zhengmai9023; 3: Zhengmai9023; 4-5: transgenic plants of Jimai22; 6: Jimai22; 7-8: transgenic plants of Xinong 979; 9: Xinong979; 11-12: transgenic plants of Aikang58; 13: Aikang 58; 14-15: transgenic plants of Jing 411; 16: Jing411; 18-19: transgenic plants of Zhoumai18; 20: Zhoumai18; 21-22: transgenic plants of Sumai3; 23: Sumai 3; 26-27: transgenic plants of Zhengmai7698; 28: Zhengmai7698; 29-30: transgenic plants of Kenong199; 31: Kenong199; 32-33: transgenic plants of Yangmai16; 33: Yangmai16; 24 and 35: plasmid of TaCB1 vector; 10, 17, 25 and 36: DL15000 DNA marker.



**Extended data Fig. 4** Comparison of the transient infection efficiency of different wheat varieties by expressing anthocyanin biosysthesis genes *ZmR* and *ZmC1* as visible marker.



**Extended data Fig. 5** Normal growth of the regeneration shoots derived from a transformed immature embryo on the premise of *TaCB1* gene in three experiment repeats.

**Supplementary Table 1** **Summary of information on the *TaCB1* and *TaCB2* genes identified in this study.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Gene | Species | mRNA length (bp) | Protein length (aa) | GenBank ID |
| *TaCB1* | *T. aestivum* | 633 | 210 | MN412513 |
| *TaCB1-1* | *T. aestivum* | 633 | 210 | MN412514 |
| *TaCB1-2* | *T. aestivum* | 639 | 212 | MN412515 |
| *AsCB1-1* | *Ae. speltoides* | 624 | 207 | MN412510 |
| *AsCB1-2* | *Ae. speltoides* | 630 | 209 | MN412511 |
| *AsCB1-3* | *Ae. speltoides* | 630 | 209 | MN412512 |
| *TmCB1-1* | *T. monococcum* | 639 | 212 | MN412516 |
| *TmCB1-2* | *T. monococcum* | 630 | 209 | MN412517 |
| *TmCB1-3* | *T. monococcum* | 627 | 208 | MN412518 |
| *TaWUS-A* | *T. aestivum* | 927 | 308 | MW452946 |
| *TaWUS-B* | *T. aestivum* | 921 | 306 | MW452947 |
| *TaWUS-D* | *T. aestivum* | 927 | 308 | MW452945 |

**Supplementary Table 2 The detailed transformation results of 29 wheat genotypes with *TaCB1* and common vectors.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Genotypes | | The common vector | | | | |  |  | | The *TaCB1* vector | | |
| No. of explants transformed | No. of experiments | Positive plants | Transformation efficiency (%) | |  | No. of explants transformed | No. of experiments | | Positive plants | Transformation efficiency (%) |
| B037 | 1198 | | 17 | 478 | 39.9 |  | | 341 | 4 | | 338 | 96.2 |
| Fielder | 2322 | | 32 | 1045 | 45.0 |  | | 3290 | 39 | | 3108 | 94.5 |
| Zhoumai18 | 2029 | | 23 | 240 | 11.8 |  | | 981 | 15 | | 908 | 92.6 |
| Zhengmai1342 | 166 | | 2 | 9 | 5.4 |  | | 1056 | 10 | | 924 | 87.5 |
| Bs366 | 272 | | 3 | 0 | 0 |  | | 266 | 3 | | 222 | 83.5 |
| Zhongmai895 | 510 | | 5 | 30 | 5.9 |  | | 571 | 7 | | 472 | 82.7 |
| Ji5265 | 948 | | 12 | 123 | 13.0 |  | | 99 | 2 | | 80 | 80.8 |
| Yangmai16 | 688 | | 7 | 43 | 9.3 |  | | 2009 | 19 | | 1622 | 80.7 |
| Jingdong18 | 504 | | 6 | 72 | 14.3 |  | | 1966 | 18 | | 1570 | 79.8 |
| Kenong199 | 1781 | | 18 | 315 | 17.7 |  | | 1069 | 11 | | 809 | 75.7 |
| Yangmai58 | 40 | | 1 | 3 | 7.5 |  | | 123 | 1 | | 90 | 73.2 |
| Xinchun9 | 165 | | 2 | 22 | 13.3 |  | | 147 | 2 | | 106 | 72.1 |
| Lunxuan987 | 503 | | 6 | 27 | 5.4 |  | | 508 | 6 | | 336 | 68.5 |
| PM97033 | 94 | | 1 | 14 | 14.9 |  | | 197 | 3 | | 129 | 65.4 |
| Zhengmai7698 | 2196 | | 24 | 229 | 10.4 |  | | 1108 | 13 | | 682 | 61.6 |
| Zhengmai1860 | 938 | | 11 | 101 | 10.8 |  | | 975 | 10 | | 580 | 59.5 |
| Sumai3 | 150 | | 2 | 4 | 2.67 |  | | 662 | 7 | | 380 | 57.4 |
| Jimai22 | 701 | | 7 | 41 | 5.8 |  | | 5459 | 69 | | 3023 | 55.4 |
| Zhengmai9023 | 60 | | 1 | 7 | 11.7 |  | | 232 | 5 | | 74 | 31.8 |
| Ningchun4 | 136 | | 2 | 0 | 0 |  | | 441 | 4 | | 129 | 29.3 |
| AiKang58 | 434 | | 5 | 0 | 0 |  | | 142 | 2 | | 31 | 21.8 |
| Jing411 | 377 | | 3 | 8 | 2.1 |  | | 388 | 6 | | 68 | 17.5 |
| Xinong979 | 144 | | 2 | 0 | 0 |  | | 245 | 3 | | 41 | 16.7 |
| Sunstate | 113 | | 1 | 0 | 0 |  | | 374 | 4 | | 34 | 9.1 |
| Zhengmai6694 | - | | - | - | - |  | | 1008 | 13 | | 986 | 97.8 |
| Zhengmai9170 | - | | - | - | - |  | | 450 | 5 | | 412 | 91.6 |
| Zhongmai175 | - | | - | - | - |  | | 374 |  | | 236 | 63.1 |
| Luohanmai | - | | - | - | - |  | | 237 | 3 | | 41 | 17.3 |
| Cang6005 | - | | - | - | - |  | | 131 | 2 | | 8 | 6.1 |

-: no data.

**Supplementary Table 3 Main botanic and agronomic characters of the transgenic wheat plants overexpressing *TaCB1*.**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Plant height (cm) | Stem diameter (mm) | Leaf width (cm) | Leaf length (cm) | Leaf area (cm2) | Chlorophyll content | Grain number per spike | Thousand grain weight (g) | Grain length (mm) | Grain width (mm) | Length-width ratio |
| Fielder-*TaCB1* | 86.49±2.99 | 4.21±0.21 | 2.67±0.21 | 18.40±1.08 | 35.27±7.08 | 48.24±1.56 | 46.60±5.96 | 42.61±2.12 | 6.17±0.11 | 3.13±0.08 | 1.98±0.02 |
| Fielder-WT | 90.69±2.29 | 3.54±0.04 | 1.90±0.03 | 19.72±0.43 | 27.76±1.31 | 48.03±1.32 | 48.55±6.95 | 41.31±1.29 | 6.10±0.08 | 3.07±0.04 | 2.00±0.04 |