## Supplementary Information

**Article title:**
*OsCOP1* regulates embryo development and flavonoid biosynthesis in rice (*Oryza sativa* L.)

**Journal:**

Theoretical and applied genetics

**Authors:**

Backki Kim, Rihua Piao, Gileung Lee, Eunbyeol Koh, Yunjoo Lee, Sunmin Woo, Reflinur, Wenzhu Jiang, Endang M. Septiningsih, Michael J. Thomson, and Hee-Jong Koh

**Name, affiliation, and email of corresponding author:**

Hee-Jong Koh

Department of Plant Science, Research Institute for Agriculture and Life Sciences, and Plant Genomics and Breeding Institute, Seoul National University, Seoul 08826, Republic of Korea

E-mail: heejkoh@snu.ac.kr

**Content:**

**Table S1.** Information of the primers used in this study

| Oligo name | Forward primer (5'-3') | Reverse primer (5'-3') | Purpose | Note |
|---|---|---|---|---|
| S02135 | GAGTGCGGAACTGTGGAAGT | GGATATCCTCCATTAAGAGAGAAGTG | Mapping | InDel |
| S02C | GAGCCTTCCTCCCCACTC | TATCTCTACCGGCAGCATCC | Mapping | InDel |
| S02F | CATGTGATCCCCAAGAATCC | TGGCCCTACTGCTAATTGCT | Mapping | InDel |
| S02I | CTCGGTGTCGTACAGCTTCA | TCCTGTCCGCTTCAGGTAAC | Mapping | InDel |
| S02K-1 | GGCTCTTCTTGTCCATGAGC | GACTACTCGCCGCAGAGC | Mapping | InDel |
| S02K-2 | GTGAGAGAATTTCAATCGGTGA | CATGCACACGTTTCGGTACT | Mapping | InDel |
| S02M | AACTTGAGGTCTAGCCCAGAGA | ATGTTGAGCCCACGTATCAG | Mapping | InDel |
| S02140 | TGGGAGGAGGATATTGTGGA | TGACAGGTTGATGTGATGGAA | Mapping | InDel |
| yel_hc_cs | GTCTCCTCCCACCCATACAC | TGTCCACTGCTGGTGATTCT | Co-segregation analysis for yel_hc | InDel |
| yel_sk_cs | AAAATGTCAGCTCGCCAAAT | CAAGCACAGCTAAGGTACGG | Co-segregation analysis for yel_sk | CAPS (Mbo I) |
| yel_cc_cs | AATTTGACCGTGATGATGAGC | ACCCTCATAGTCGCTGCTTG | Co-segregation analysis for yel_cc | CAPS (Taq I) |
| COP1_RFg1 | gtgtgCCACCGTCGAGTCACCCATG | aaacCATGGGTGACTCGACGGTGGc | CRISPR/Cas9 construct | |
| COP1_RFg2 | gtgtgCGGGCAGAGGAGGTCCCTGT | aaacACAGGGACCTCCTCTGCCCGc | CRISPR/Cas9 construct | |
| COP1_CCg1 | gtgtgTAGTCTTATGACTTTGATCG | aaacCGATCAAAGTCATAAGACTAc | CRISPR/Cas9 construct | |
| COP1_CCg2 | gtgtgCAAAGAAGATATAAGTGCTG | aaacCAGCACTTATATCTTCTTTGc | CRISPR/Cas9 construct | |
| COP1_WDg1 | gtgtGATGAGCTATTTGCTACTGC | aaacGCAGTAGCAAATAGCTCATC | CRISPR/Cas9 construct | |
| COP1_WDg2 | gtgtgATGAGGGTATAGTAACTGTT | aaacAACAGTTACTATACCCTCATc | CRISPR/Cas9 construct | |
| OsCOP1_HC_OX | GCAATTATTCACGCCCAGTC | TGATGTTCATTTCTCAATTCTCACG | Overexpression | |
| OsCOP1_HC_GUS | AAAAAGCAGGCTCTGAACCCCAGTCCTCGTTA | AGAAAGCTGGGTGCGGCAGGAGGAGGCCGCCC | GUS assay | |
| RT_OsCOP1 | GGGAGTGAAACGAATGAGGT | TCCAGCAGACTGCGCTAATA | qRT-PCR | |
| yel_type_G | GTCTCCTCCCACCCATACAC | TGTCCACTGCTGGTGATTCT | Transgenic seed genotyping | *yel* |
| WT_type_G | GCATCTCAGCCACAAGAGC | TGTCCACTGCTGGTGATTCT | Transgenic seed genotyping | *YEL* |
| 35S_*OsCOP1*_G | CTATCCTTCGCAAACCCTTC | GGAGGAAGTTGGGGTAGAGC | Transgenic seed genotyping | 35S_*OsCOP1* |
| HPT | GTAAATAGCTGCGCCGATGG | TACTTCTACACAGCCATCGG | Transgenic seed genotyping | HPT |

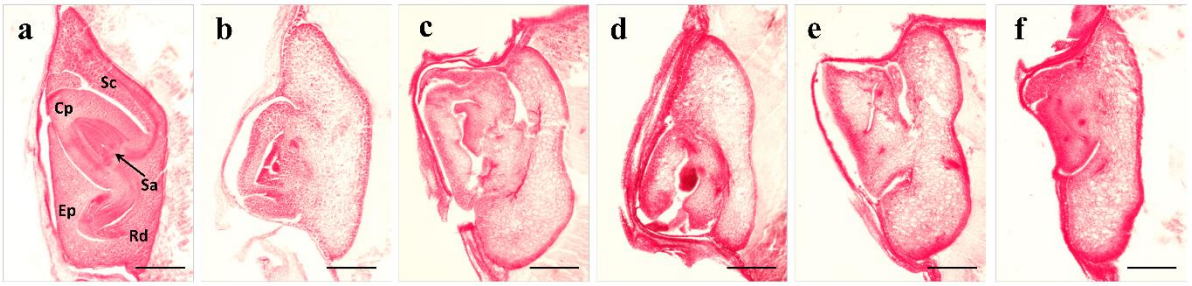


**Fig. S1.** Longitudinal sections of wild-type (Hwacheong) and *yel-hc* mature embryos. **a.** Mature wild-type embryo (40 DAP). **B-f.** Mature *yel-hc* mutant embryos (Bar = 300 μm). Cp, coleoptile; Ep, epiblast; Rd, radicle; Sc, scutellum; Sa, shoot apex.

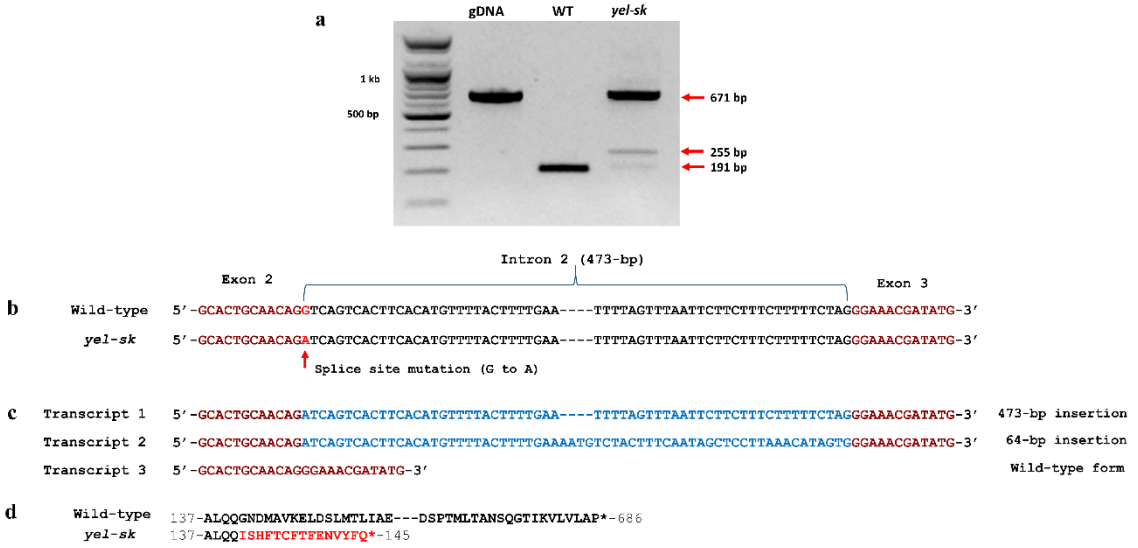


**Fig. S2.** Detection and analysis of *YEL* transcripts. **a.** RT-PCR analysis of *YEL* transcripts in wild-type and *yel-sk*. Numbers indicate amplicon lengths. **b.** Genomic DNA sequence and mutation point of wild type and *yel-sk*. **c.** Wild-type sequence and alternatively spliced transcript sequences in the *yel-sk* mutant. **d.** Comparison of wild-type and *yel-sk* amino acid sequences. The stop codon is indicated with an asterisk.

**Table S2.** Genotype for overexpression transgene and *YEL*/*yel* background in $F_2$ transgenic seeds

| NO | Sub. No. | Phenotype of $F_2$ seed | Genotype | | | | |
|---|---|---|---|---|---|---|---|
| | | | ***yel*** | ***YEL*** | **35S_*OsCOP*1** | **HPT** | **Genotype of $F_2$ seed** |
| 1 | YEL_OX-1-Y-1 | yel mutant-type | + | - | - | - | yel/yel |
| 2 | YEL_OX-1-Y-2 | yel mutant-type | + | - | - | - | yel/yel |
| 3 | YEL_OX-1-Y-3 | yel mutant-type | + | - | - | - | yel/yel |
| 4 | YEL_OX-1-Y-4 | yel mutant-type | + | - | - | - | yel/yel |
| 5 | YEL_OX-1-Y-5 | yel mutant-type | + | - | - | - | yel/yel |
| 6 | YEL_OX-1-Y-6 | yel mutant-type | + | - | - | - | yel/yel |
| 7 | YEL_OX-3-Y-1 | yel mutant-type | + | - | - | - | yel/yel |
| 8 | YEL_OX-3-Y-2 | yel mutant-type | + | - | - | - | yel/yel |
| 9 | YEL_OX-3-Y-3 | yel mutant-type | + | - | - | - | yel/yel |
| 10 | YEL_OX-3-Y-4 | yel mutant-type | + | - | - | - | yel/yel |
| 11 | YEL_OX-4-Y-1 | yel mutant-type | + | - | - | - | yel/yel |
| 12 | YEL_OX-4-Y-2 | yel mutant-type | + | - | - | - | yel/yel |
| 13 | YEL_OX-5-Y-1 | yel mutant-type | + | - | - | - | yel/yel |
| 14 | YEL_OX-5-Y-2 | yel mutant-type | + | - | - | - | yel/yel |
| 15 | YEL_OX-5-Y-3 | yel mutant-type | + | - | - | - | yel/yel |
| 16 | YEL_OX-6-Y-1 | yel mutant-type | + | - | - | - | yel/yel |
| 17 | YEL_OX-6-Y-2 | yel mutant-type | + | - | - | - | yel/yel |
| 18 | YEL_OX-6-Y-3 | yel mutant-type | + | - | - | - | yel/yel |
| 19 | YEL_OX-8-Y-1 | yel mutant-type | + | - | - | - | yel/yel |
| 20 | YEL_OX-8-Y-2 | yel mutant-type | + | - | - | - | yel/yel |
| 21 | YEL_OX-1-P-1 | Partial recovery-type | + | - | + | + | yel/yel + 35S_OsCOP1 |
| 22 | YEL_OX-1-P-2 | Partial recovery-type | + | - | + | + | yel/yel + 35S_OsCOP1 |
| 23 | YEL_OX-1-P-3 | Partial recovery-type | + | - | + | + | yel/yel + 35S_OsCOP1 |
| 24 | YEL_OX-1-P-4 | Partial recovery-type | + | - | + | + | yel/yel + 35S_OsCOP1 |
| 25 | YEL_OX-1-P-5 | Partial recovery-type | + | - | + | + | yel/yel + 35S_OsCOP1 |
| 26 | YEL_OX-3-P-1 | Partial recovery-type | + | - | + | + | yel/yel + 35S_OsCOP1 |
| 27 | YEL_OX-3-P-2 | Partial recovery-type | + | - | + | + | yel/yel + 35S_OsCOP1 |
| 28 | YEL_OX-3-P-3 | Partial recovery-type | + | - | + | + | yel/yel + 35S_OsCOP1 |
| 29 | YEL_OX-3-P-4 | Partial recovery-type | + | - | + | + | yel/yel + 35S_OsCOP1 |
| 30 | YEL_OX-5-P-1 | Partial recovery-type | + | - | + | + | yel/yel + 35S_OsCOP1 |
| 31 | YEL_OX-5-P-2 | Partial recovery-type | + | - | + | + | yel/yel + 35S_OsCOP1 |
| 32 | YEL_OX-5-P-3 | Partial recovery-type | + | - | + | + | yel/yel + 35S_OsCOP1 |
| 33 | YEL_OX-5-P-4 | Partial recovery-type | + | - | + | + | yel/yel + 35S_OsCOP1 |
| 34 | YEL_OX-5-P-5 | Partial recovery-type | + | - | + | + | yel/yel + 35S_OsCOP1 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 35 | YEL_OX-6-P-1 | Partial recovery-type | + | - | + | + | yel/yel + 35S_OsCOP1 |
| 36 | YEL_OX-6-P-2 | Partial recovery-type | + | - | + | + | yel/yel + 35S_OsCOP1L |
| 37 | YEL_OX-8-P-1 | Partial recovery-type | + | - | + | + | yel/yel + 35S_OsCOP1 |
| 38 | YEL_OX-8-P-2 | Partial recovery-type | + | - | + | + | yel/yel + 35S_OsCOP1 |
| 39 | YEL_OX-8-P-3 | Partial recovery-type | + | - | + | + | yel/yel + 35S_OsCOP1 |
| 40 | YEL_OX-8-P-4 | Partial recovery-type | + | - | + | + | yel/yel + 35S_OsCOP1 |
| 41 | YEL_OX-1-N-1 | Normal-type | - | + | + | + | YEL/YEL + 35S_OsCOP1 |
| 42 | YEL_OX-1-N-2 | Normal-type | - | + | + | + | YEL/YEL + 35S_OsCOP1 |
| 43 | YEL_OX-1-N-3 | Normal-type | + | + | + | + | YEL/yel + 35S_OsCOP1 |
| 44 | YEL_OX-1-N-4 | Normal-type | + | + | + | + | YEL/yel + 35S_OsCOP1 |
| 45 | YEL_OX-1-N-5 | Normal-type | - | + | - | - | YEL/YEL |
| 46 | YEL_OX-1-N-6 | Normal-type | + | + | + | + | YEL/yel + 35S_OsCOP1 |
| 47 | YEL_OX-1-N-7 | Normal-type | + | + | + | + | YEL/yel + 35S_OsCOP1 |
| 48 | YEL_OX-1-N-8 | Normal-type | + | + | + | + | YEL/yel + 35S_OsCOP1 |
| 49 | YEL_OX-1-N-9 | Normal-type | + | + | - | - | YEL/yel |
| 50 | YEL_OX-1-N-10 | Normal-type | + | + | + | + | YEL/yel + 35S_OsCOP1 |
| 51 | YEL_OX-3-N-1 | Normal-type | - | + | + | + | YEL/YEL + 35S_OsCOP1 |
| 52 | YEL_OX-3-N-2 | Normal-type | + | + | - | - | YEL/yel |
| 53 | YEL_OX-3-N-3 | Normal-type | + | + | + | + | YEL/yel + 35S_OsCOP1 |
| 54 | YEL_OX-3-N-4 | Normal-type | + | + | + | + | YEL/yel + 35S_OsCOP1 |
| 55 | YEL_OX-3-N-5 | Normal-type | - | + | - | - | YEL/YEL |
| 56 | YEL_OX-3-N-6 | Normal-type | - | + | + | + | YEL/YEL + 35S_OsCOP1 |
| 57 | YEL_OX-3-N-7 | Normal-type | + | + | + | + | YEL/yel + 35S_OsCOP1 |
| 58 | YEL_OX-3-N-8 | Normal-type | + | + | - | - | YEL/yel |
| 59 | YEL_OX-3-N-9 | Normal-type | + | + | + | + | YEL/yel + 35S_OsCOP1 |
| 60 | YEL_OX-3-N-10 | Normal-type | + | + | + | + | YEL/yel + 35S_OsCOP1 |
| 61 | YEL_OX-5-N-1 | Normal-type | + | + | + | + | YEL/yel + 35S_OsCOP1 |
| 62 | YEL_OX-5-N-2 | Normal-type | + | + | + | + | YEL/yel + 35S_OsCOP1 |
| 63 | YEL_OX-5-N-3 | Normal-type | - | + | + | + | YEL/YEL + 35S_OsCOP1 |
| 64 | YEL_OX-5-N-4 | Normal-type | - | + | + | + | YEL/YEL + 35S_OsCOP1 |
| 65 | YEL_OX-5-N-5 | Normal-type | - | + | + | + | YEL/YEL + 35S_OsCOP1 |
| 66 | YEL_OX-5-N-6 | Normal-type | + | + | + | + | YEL/yel + 35S_OsCOP1 |
| 67 | YEL_OX-5-N-7 | Normal-type | + | + | - | - | YEL/yel |
| 68 | YEL_OX-5-N-8 | Normal-type | - | + | + | + | YEL/YEL + 35S_OsCOP1 |
| 69 | YEL_OX-5-N-9 | Normal-type | + | + | + | + | YEL/yel + 35S_OsCOP1 |
| 70 | YEL_OX-5-N-10 | Normal-type | - | + | + | + | YEL/YEL + 35S_OsCOP1 |
| 71 | YEL_OX-6-N-1 | Normal-type | - | + | + | + | YEL/YEL + 35S_OsCOP1 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 72 | YEL_OX-6-N-2 | Normal-type | + | + | + | + | YEL/yel + 35S_OsCOP1 |
| 73 | YEL_OX-6-N-3 | Normal-type | + | + | + | + | YEL/yel + 35S_OsCOP1 |
| 74 | YEL_OX-6-N-4 | Normal-type | + | + | + | + | YEL/yel + 35S_OsCOP1 |
| 75 | YEL_OX-6-N-5 | Normal-type | + | + | + | + | YEL/yel + 35S_OsCOP1 |
| 76 | YEL_OX-6-N-6 | Normal-type | + | + | - | - | YEL/yel |
| 77 | YEL_OX-6-N-7 | Normal-type | + | + | - | - | YEL/yel |
| 78 | YEL_OX-6-N-8 | Normal-type | - | + | + | + | YEL/YEL + 35S_OsCOP1 |
| 79 | YEL_OX-6-N-9 | Normal-type | - | + | - | - | YEL/YEL |
| 80 | YEL_OX-6-N-10 | Normal-type | - | + | - | - | YEL/YEL |
| 81 | YEL_OX-8-N-1 | Normal-type | + | + | - | - | YEL/yel |
| 82 | YEL_OX-8-N-2 | Normal-type | + | + | - | - | YEL/yel |
| 83 | YEL_OX-8-N-3 | Normal-type | + | + | + | + | YEL/yel + 35S_OsCOP1 |
| 84 | YEL_OX-8-N-4 | Normal-type | + | + | + | + | YEL/yel + 35S_OsCOP1 |
| 85 | YEL_OX-8-N-5 | Normal-type | + | + | + | + | YEL/yel + 35S_OsCOP1 |
| 86 | YEL_OX-8-N-6 | Normal-type | + | + | - | - | YEL/yel |
| 87 | YEL_OX-8-N-7 | Normal-type | + | + | + | + | YEL/yel + 35S_OsCOP1 |
| 88 | YEL_OX-8-N-8 | Normal-type | + | + | - | - | YEL/YEL + 35S_OsCOP1 |
| 89 | YEL_OX-8-N-9 | Normal-type | + | + | - | - | YEL/yel |
| 90 | YEL_OX-8-N-10 | Normal-type | + | + | + | + | YEL/yel + 35S_OsCOP1 |
| 91 | YEL_OX-8-N-11 | Normal-type | + | + | - | - | YEL/yel |
| 92 | YEL_OX-8-N-12 | Normal-type | - | + | - | - | YEL/YEL |
| 93 | YEL_OX-8-N-13 | Normal-type | - | + | - | - | YEL/YEL |

*yel*: *yel-hc* allele (mutant), *YEL*: *YEL* allele (wild-type), 35S_*OsCOP1*: Overexpression transgene, HPT: hygromycin B selection