Supplemental material

Critical analysis of protein signaling networks involved in the regulation of plant secondary metabolism: focus on anthocyanins

Victor P. Bulgakov, Tatiana V. Avramenko, Gurami Sh. Tsitsiashvili

PAP1

TCP3, CYCLOIDEA AND PCF TRANSCRIPTION FACTOR 3; COP1, CONSTITUTIVE PHOTOMORPHOGENIC 1; JAZ1, JASMONATE-ZIM-DOMAIN PROTEIN 1; SPL9, SQUAMOSA PROMOTER BINDING PROTEIN-LIKE 9; GL3, TRANSCRIPTION FACTOR GLABRA 3; EGL3, ENHANCER OF GLABRA 3; SPA2, SPA1-RELATED 2; ELONGATED HYPOCOTYL 5.

HY5

FAR1, FAR-RED IMPAIRED RESPONSE 1; PIF3, PHYTOCHROME INTERACTING FACTOR 3; LZF1, LIGHT-REGULATED ZINC FINGER PROTEIN 1; PIL5, PHYTOCHROME INTERACTING FACTOR 3-LIKE 5; HYH, HY5-HOMOLOG; STH, SALT TOLERANCE HOMOLOGUE; CIP8, COP1-INTERACTING PROTEIN 8; SPA1, SUPPRESSOR OF PHYA-105 1; STH2, SALT TOLERANCE HOMOLOG2; DET, DE-ETIOLATED 1; CAM7, CALMODULIN 7.

MYC2

JAZs, JASMONATE-ZIM-DOMAIN PROTEINs, TIFY10B, JASMONATE-ZIM-DOMAIN PROTEIN 2; TIFY7, JASMONATE-ZIM-DOMAIN PROTEIN 9; AHP5, HISTIDINE-CONTAINING PHOSPHOTRANSFER FACTOR 5; RGA1, REPRESSOR OF GA; GAI, GIBBERELLIC ACID INSENSITIVE; TIC, TIME FOR COFFEE.

TCP3

GPA1, G PROTEIN ALPHA SUBUNIT; TCPs, CYCLOIDEA AND PCF TRANSCRIPTION FACTORS; TT2, TRANSPARENT TESTA 2; TPL, TOPLESS.

Suppl. Fig. 1. First neighbors of some hub-type proteins that important for anthocyanin regulation

IAAs, INDOLE-3-ACETIC ACID INDUCIBLE; ARFs, AUXIN RESPONSE FACTORS; GRH1, GERMIN-LIKE PROTEIN 1; AXRs, AUXIN RESISTANT; RCE1, RUB1 CONJUGATING ENZYME 1; TIR1, TRANSPORT INHIBITOR RESPONSE 1; AFB3, AUXIN SIGNALING F-BOX 3; WSIP2/TPR4, WUS-INTERACTING PROTEIN 2/TOPLESS-RELATED 4; ATAUX2-11, auxin-responsive protein IAA4.

Suppl. Fig. 3. Cryptochrome signaling. The interactions of cryptochromes CRY1 and CRY2 are presented as red edges. The interactions PAP1/HY5-COP1/SPA1-CRY1/CRY2 mediate the activation of anthocyanin biosynthesis under blue light, via repression of the COP1/SPA ubiquitin ligase. The CRY1-ZTL interaction provides a link of this module with circadian rhythm.

PRR5, PSEUDO-RESPONSE REGULATOR 5; SK11, S-PHASE KINASE-ASSOCIATED PROTEIN 1; ZTL, ADAGIO 1; TOC1, TIMING OF CAB EXPRESSION 1; SRK2A, SERINE/THREONINE KINASE 1; LKP2, LOV KELCH PROTEIN 2; RBX1, REGULATOR OF CULLINS-1; COL1, CONSTANS-LIKE 1; CRYs, CRYPTOCHROMES; PHYB, PHYTOCHROME B; COP1, CONSTITUTIVE PHOTOMORPHOGENIC 1; SPA1, SUPPRESSOR OF PHA-105 1; CUL4, CULLIN4; FUS9, CONSTITUTIVE PHOTOMORPHOGENESIS PROTEIN 10; DDB1B, DAMAGED DNA BINDING PROTEIN 1B; COP13, COP9 SIGNALOSOME COMPLEX SUBUNIT 3.

Suppl. Fig. 4. CaM7 signaling. The first and second neighbors of CaM7 are shown. DRBs, DSRNA-BINDING PROTEINS; HYL1, HYPONASTIC LEAVES 1; DCL1, ENDORIBONUCLEASE DICER; DCL3, DICER-LIKE 3; HYH, HY5-HOMOLOG; RBK1, ROP BINDING PROTEIN KINASE 1; CYP705As, CYTOCHROME P450, FAMILY 705, SUBFAMILY A POLYPEPTIDES; CK11, CASEIN KINASE I-LIKE 11, AHPs, HISTIDINE-CONTAINING PHOSPHOTRANSMITTERS; BAG6, BCL-2-ASSOCIATED ATHANOGENE 6; WRKY21, WRKY DNA-BINDING PROTEIN 21; WRKY53, PUTATIVE WRKY TRANSCRIPTION FACTOR 53; MEKK1, MITOGEN-ACTIVATED PROTEIN KINASE KINASE KINASE 1; CPKs/CDPKs, CALCIUM-DEPENDENT PROTEIN KINASEs; ABF4, ABSCISIC ACID-INSENSITIVE 5-LIKE PROTEIN 7; AFPs, NINJA-FAMILY ABI FIVE BINDING PROTEINS; BI1, BAX INHIBITOR 1; CB5-B, PUTATIVE CYTOCHROME B5 ISOFORM 2; LSD1, LESION SIMULATING DISEASE; BZO2H1, BASIC LEUCINE ZIPPER 10; BZIP1, BASIC LEUCINE-ZIPPER 1; BZIP53, BASIC REGION/LEUCINE ZIPPER MOTIF 53; EP1, PUTATIVE CYSTEINE-RICH RECEPTOR-LIKE PROTEIN KINASE 9; ABIs, ABA INSENSITIVES; MADS-BOX, MADS-BOX DOMAIN-CONTAINING PROTEIN; AGLs, AGAMOUS-LIKE PROTEINS; STK, AGAMOUS-LIKE MADS-BOX PROTEIN AGL11; CAL, CAULIFLOWER; SVP, SHORT VEGETATIVE PHASE; SHPs, SHATTERPROOF PROTEINS; AG, AGAMOUS; SEP4, SEPALLATA 4; SERK1, SOMATIC EMBRYOGENESIS RECEPTOR-LIKE KINASE 1; GRF2, GENERAL REGULATORY FACTOR 2; HSP81-2, HEAT SHOCK PROTEIN 81-2; SOS2 (SYNONYM: CIPK24, CBL-INTERACTING PROTEIN KINASE 24); SOS3 (SYNONYM: CBL4, CALCINEURIN B-LIKE PROTEIN 4);

SIP3, CBLs, CALCINEURIN B-LIKE PROTEINs; SIP3, CBL-INTERACTING PROTEIN KINASE 6.

Suppl. Fig. 5. PYL4 signaling. The first neighbors of PYL4 are indicated as yellow nodes.

PP2CA, PROTEIN PHOSPHATASE 2C 37; SCAR2, IRREGULAR TRICHOME BRANCH1; SNRKs, SERINE/THREONINE-PROTEIN KINASEs; KT2/3, POTASSIUM CHANNEL AKT2/3; HAB1, HOMOLOGY TO ABI1; RCARs, REGULATORY COMPONENTs OF ABA RECEPTOR; AT4G18340, GLYCOSYL HYDROLASE FAMILY 17 PROTEIN; RBOH F, RESPIRATORY BURST OXIDASE PROTEIN F; AHG1, ABA-HYPERSENSITIVE GERMINATION 1; OST1, OPEN STOMATA 1; HA1, HIGHLY ABA-INDUCED PP2C GENE 1; RPN1A, 26S PROTEASOME REGULATORY SUBUNIT N1; UBA2A, UBP1-ASSOCIATED PROTEIN 2A; HB6, HOMEBOX-LEUCINE ZIPPER PROTEIN ATHB-6; ACS2, 1-AMINOCYCLOPROPANE-1-CARBOXYLATE SYNTHASE 2; RPN10, REGULATORY PARTICLE NON-ATPASE 10; HBT, CELL DIVISION CYCLE PROTEIN 27-B; FCA, FLOWERING TIME CONTROL PROTEIN FCA ALPHA; BRM, ATP-DEPENDENT HELICASE BRM; CHB3, SWITCH/SUCROSE NONFERMENTING 3D; BSH, BUSHY GROWTH; SWI3s, SWI/SNF COMPLEX SUBUNITs SWI3; SYD, ATPASE SPLAYED; PYR1, REGULATORY COMPONENT OF ABA RECEPTOR 11; CIPKs, CBL-INTERACTING SERINE/THREONINE-PROTEIN KINASEs; PYLs, PYR1-LIKE REGULATORY COMPONENTs OF ABA RECEPTORS; ATJ3, CHAPERONE PROTEIN DNAJ 3; HAs, H(+)-ATPASEs; CIP4, COP1-INTERACTING PROTEIN 4; TCPs, CYCLOIDEA AND PCF TRANSCRIPTION FACTORS; COI1, CORONATINE-INSENSITIVE PROTEIN 1.

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Suppl. Fig. 6. The overlapping function of MYC2 and TCP3 in cytokinin signaling. The bHLH transcription factors MYC2 and TCP3 interact with the same targets (AHP1, AHP2 and AHP3) in different ways; MYC2 interacts via two-component response regulators, whereas TCP3 interacts via the branched chain of TCP interactions. The yellow-brown nodes on the right of the figure represent proteins that are involved in the hypersensitive response (HR).

GRFs, GENERAL REGULATORY FACTORS; ETRs, ETHYLENE RESPONSE PROTEINs; PP2A-1, PROTEIN PHOSPHATASE 2A-2; EIN4, ETHYLENE INSENSITIVE 4; CTR1, CONSTITUTIVE TRIPLE RESPONSE 1; CRT1A, CALRETICULIN 1; ERS1, ETHYLENE RESPONSE SENSOR 1; EIN2, ETHYLENE INSENSITIVE 2; ETP, EIN2 TARGETING PROTEIN; AHPs, HISTIDINE-CONTAINING PHOSPHOTRANSMITTERs; ARR/RRs, RESPONSE REGULATORS; HK1, HISTIDINE KINASE 1; ATMND1, MEIOTIC NUCLEAR DIVISION PROTEIN 1-LIKE PROTEIN; CKI1, CASEIN KINASE I-LIKE 11; HKs, HISTIDINE KINASEs; STOP1, SENSITIVE TO PROTON RHIZOTOXICITY 1; ATAF2, ARABIDOPSIS NAC DOMAIN CONTAINING PROTEIN 81; SUI1-1, PROTEIN TRANSLATION FACTOR; ZAT7, ZINC FINGER-CONTAINING PROTEIN; HR PROTEIN 2, HYPERSENSITIVE-INDUCED RESPONSE PROTEIN 2; RPS2, DISEASE RESISTANCE PROTEIN RPS2; PIP1B, PLASMA MEMBRANE INTRINSIC PROTEIN 1B; WOL, HISTIDINE KINASE 4; FAC1, ADENOSINE 5'-MONOPHOSPHATE DEAMINASE; EER5, ENHANCED ETHYLENE RESPONSE 5; TCPs, TRANSCRIPTION FACTORs TCP; AHP5, HISTIDINE-CONTAINING PHOSPHOTRANSFER FACTOR 5; GN, EMBRYO DEFECTIVE 30; LSH1, LIGHT-DEPENDENT SHORT HYPOCOTYLS 1; BLH4, BEL1-LIKE HOMEODOMAIN 4.

Suppl. Fig. 7. GPA1 signaling. The first and second neighbors of GPA1 are shown.

HFR1, REDUCED SENSITIVITY TO FAR-RED LIGHT 1; AGB1 (G PROTEIN), ARABIDOPSIS G-PROTEIN BETA SUBUNIT; GRF2, GROWTH-REGULATING FACTOR 2; PP2A-1, PROTEIN PHOSPHATASE 2A-2; PHYB, PHYTOCHROME B; MPKs, MITOGEN-ACTIVATED PROTEIN KINASEs; MOS4, MODIFIER OF SNC1; PRN, PIRIN; GCR1, G-PROTEIN-COUPLED RECEPTOR 1; PSB29, PROTEIN THYLAKOID FORMATION 1; OEP80, OUTER ENVELOPE PROTEIN OF 80 KDA; GF14 PHI, 14-3-3 PROTEIN G-BOX FACTOR14 PHI.