Supplementary Material

Article Title Genome-wide identification of soybean cytokinin oxidase/dehydrogenase (CKX) gene family and its diverse roles in response to multiple abiotic stress

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Figure S2. Phylogenetic tree of GmCKX proteins in soybean.

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Figure S1. Chemical structure of CTK.



Figure S2. Phylogenetic tree of GmCKX proteins in soybean.

## Supplementary Tables

Table S1: Specific primers for qRT-PCR

|  |  |  |  |
| --- | --- | --- | --- |
| Primer | Sequence (5 'to 3') | Primer | Sequence (5 'to 3') |
| GmCKX01\_F  | TGAAGGTGCACGAAGTTTCACTTG | GmCKX11\_F  | TCTGTGCGAATGCTGGTATTGGG |
| GmCKX01\_R | AATTATTGAGAGCAAGGCCAGAGG | GmCKX11\_R | ACTGCTTCTCCCATTCTTCCTGTG |
| GmCKX02\_F  | AGTGGACCCAGTTCAATGCTAGG | GmCKX12\_F  | GCTCCAAGGACTAGCCTATATCCC |
| GmCKX02\_R | TGCTGGCCTGTGGCTAAGATTC | GmCKX12\_R | CCACAGTCCTTGTGACTGAAGC |
| GmCKX03\_F  | ACGGGAGGATTGGATCAAGCAC | GmCKX13\_F  | TCGTAACCAAGACCATCCTTCCG |
| GmCKX03\_R | TTGGCCTTTCGCTCCGCAAATC | GmCKX13\_R | TTAGACCCTCGACGAATCGTAGCC |
| GmCKX04\_F  | TGGTGAAGGCAGGGTTCAAGTC | GmCKX14\_F  | ACGTTGCTGGGATCAAGGTTAAG |
| GmCKX04\_R | GCTTGCCCGTTTATCGAATGTCC | GmCKX14\_R | GCCCAATCTTCTTGTGTGCGATAG |
| GmCKX05\_F  | TGCTTAGGTCAGAAGGACTTTGGG | GmCKX15\_F  | AAACTCCATGATGACCCTGAAACC |
| GmCKX05\_R | TCTTGGAACCCAGAGGTTCAGC | GmCKX15\_R | GCGTTAAATGGCCATAGTCCCTTG |
| GmCKX06\_F  | TGTTGCCGAGCTAGTTCTTAGGC | GmCKX16\_F  | CAGGGCAAGAATAGCTCTTGGG |
| GmCKX06\_R | CCAGATGTTCAACCAAGGATGAGG | GmCKX16\_R | GAGAAATCGTTGTACAGCAAACGG |
| GmCKX07\_F  | CAATGGATGAAGGCCCTAACGC | GmCKX17\_F  | AGGCCAGTGAGATGGATAAGGG |
| GmCKX07\_R | AGCTTGCTGAAGATGGTGTCATCG | GmCKX17\_R | ACTCTGCGTCTCGAGTGAAGTC |
| GmCKX08\_F  | ACTACCTGCATCTCACAGTTGGTG | GmCKX18\_F  | ACCATCGTTGGTTACTCCAGAGG |
| GmCKX08\_R | GGGACCATGCCTAAATGTCTGACC | GmCKX18\_R | TTGGGAGTGCTGAGGATAGGAGTG |
| GmCKX09\_F  | ATACACCATTTCGCAGAGGTTGTC | TUBULIN A\_F | AGGTCGGAAACTCCTGCTGG |
| GmCKX09\_R | AGGGCCGTTGCTTGTTTCTTTAAC | TUBULIN A\_R | AAGGTGTTGAAGGCGTCGTG |
| GmCKX10\_F  | AACTGGAACTGACGGCCTAGAG | ACTIN\_F | CGGTGGTTCTATCTTGGCATC |
| GmCKX10\_R | TCTTGCTGTGTGTTGTAGTGAGG | ACTIN\_R | GTCTTTCGCTTCAATAACCCTA |

Table S2: Analysis and function prediction of *cis*-regulatory elements of *GmCKX* genes

|  |  |  |  |
| --- | --- | --- | --- |
| Element | Core sequence | Classification | Function |
| P-box | CCTTTTG | Hormone related elements | gibberellin-responsive element |
| ABRE | ACGTG | Hormone related elements | cis-acting element involved in the abscisic acid responsiveness |
| TGA-element | AACGAC | Hormone related elements | auxin-responsive element |
| TCA-element | CCATCTTTTT | Hormone related elements | cis-acting element involved in salicylic acid responsiveness |
| GARE-motif | TCTGTTG | Hormone related elements | gibberellin-responsive element |
| AucRR-core | GGTCCAT | Hormone related elements | cis-acting regulatory element involved in auxin responsiveness |
| TATC-box | TATCCCA | Hormone related elements | cis-acting element involved in gibberellin-responsiveness |
| LTR | CCGAAA | Resistance-related elements | cis-acting element involved in low-temperature responsiveness |
| ARE | AAACCA | Resistance-related elements | cis-acting regulatory element essential for the anaerobic induction |
| GC-motif | CCCCCG | Resistance-related elements | enhancer-like element involved in anoxic specific inducibility |
| MBS | CAACTG | Resistance-related elements | MYB binding site involved in drought-inducibility |
| MBSI | aaaAaaC(G/C)GTTA | Resistance-related elements | MYB binding site involved in flavonoid biosynthetic genes regulation |
| CAT-box | GCCACT | Development-related element | cis-acting regulatory element related to meristem expression |

Table S3: Identification of substitution rates for homologues *GmCKX* genes

|  |  |  |  |
| --- | --- | --- | --- |
| Gene pairs | Non-synonymous substitution rates (Ka) | Synonymous substitution rates (Ks) | Ka/Ks |
| GmCKX04/ GmCKX 02 | 0.01693 | 0.106003 | 0.159717 |
| GmCKX 12/ GmCKX 07 | 0.137202 | 0.898054 | 0.152777 |
| GmCKX 14/ GmCKX 07 | 0.024484 | 0.109258 | 0.22409 |
| GmCKX 10/ GmCKX 08 | 0.023345 | 0.143643 | 0.162521 |
| GmCKX 15/ GmCKX 11 | 0.319037 | 1.395714 | 0.228583 |
| GmCKX 14/ GmCKX 12 | 0.134548 | 0.909953 | 0.147862 |