

Supplementary Table S1. Primers used for the Real Time-PCR of *ZmCPK* gene family.

Name	Identifier	qPCR Primers (5'-3')
<i>ZmCDPK14</i>	GRMZM2G035843	F: ACTTGGTTTCGGCATTCTCATT R: CCTCATCATCGCTGTGAACTCG
<i>ZmCDPK15</i>	GRMZM2G047486	F: TACCGCATCGGCAAGAACT R: CTCACTGTAGTGGCCCTTGG
<i>ZmCDPK17</i>	GRMZM2G463464	F: TTTAGTCCGTAAGATGCTTATCCG R: AATAGGCTTATCAGGTGCGACA
<i>ZmCDPK22</i>	GRMZM2G058305	F: ATGAGGTGTGTCGTGTGGTCTA R: GCATTACTTTTCGCCTGGTAT
<i>ZmCDPK26</i>	GRMZM2G154489	F: TTGCGACCAAGGAGGAGAAT R: TTGCGACCAAGGAGGAGAAT
<i>ZmCDPK28</i>	GRMZM2G168706	F: CGTCCTCCCTCCAACCTCCAAGA R: TGCCTCGATGAGACAAATCAAGAG
<i>ZmCDPK36</i>	GRMZM2G028086	F: TACACGGTAGCCCGATAACA R: CAAGCGAAGAATACAAAGCAA
<i>ZmCDPK37</i>	GRMZM2G099425	F: TGTGATGCCGTGATTGTATTT R: ATGGGTCCACAGAAGTTAAGAA
<i>ZmCDPK38</i>	GRMZM2G365035	F: CAGGGCCAGAATCCGATGTT R: ATGCCTGTGCAGCAGTTAGT

Supplementary Table S2. Primers used for subcellular localization of *ZmCPK* gene family

Accession Number	Gene	Sequence
GRMZM2G035843	<i>ZmCPK14</i>	F: 5'-gagaggacagggtaccATGCAGCCGGACCCGAGCGGGA-3' R: 5'-ttgctcaccatgggtactagtGGTTTTGCTGGGATTCAAGAGT-3'
GRMZM2G047486	<i>ZmCPK15</i>	F: 5'-gagaggacagggtaccATGCAGCCGGACCCGAGCGGGA-3' R: 5'-ttgctcaccatgggtactagtGGTTTTGCTGGGATTCAAGAGT-3'
GRMZM2G463464	<i>ZmCPK17</i>	F: 5'-gagaggacagggtaccATGCAGCCGGACCCGCAAGGCC-3' R: 5'-ttgctcaccatgggtactagtCTAGGTCTCGGTGGGCTTCAGG-3'
GRMZM2G058305	<i>ZmCPK22</i>	F: 5'-gagaggacagggtaccATGGGCGGCCGCGCCTCCCGCC-3' R: 5'-ttgctcaccatgggtactagtTTAAAACATGCGCCTCCGATTT-3'
GRMZM2G154489	<i>ZmCPK26</i>	F: 5'-gagaggacagggtaccATGGGGCAGTGTTGCAGCAGAG-3' R: 5'-ttgctcaccatgggtactagtCTTGAGCCTCATTGGCTGCTGC-3'
GRMZM2G168706	<i>ZmCPK28</i>	F: 5'-gagaggacagggtaccATGGGGCAGTGTTGTAGCAGAG-3' R: 5'-ttgctcaccatgggtactagtCTTGAGCCTCATTGGCTGCTGC-3'
GRMZM2G028086	<i>ZmCPK36</i>	F: 5'-gagaggacagggtaccATGGGCAACTGCTGCGTGACGC-3' R: 5'-ttgctcaccatgggtactagtCTACCGTGTACTCGTCATCTGC-3'
GRMZM2G099425	<i>ZmCPK37</i>	F: 5'-gagaggacagggtaccATGGGCAACTGCTGCGTAACAC-3' R: 5'-ttgctcaccatgggtactagtCTGCGTACTCTCCATCTGCAAC-3'
GRMZM2G365035	<i>ZmCPK38</i>	F: 5'-gagaggacagggtaccATGGGCCTCTGCTCCTCCTCCA-3' R: 5'-accatgggtactagtgtcgacCTATGACTTGCGAACACCCCTA-3'

Supplementary Table S3. Primers for cloning *ZmCPK*, *ZmPP2C* and *ZmSnRK* family genes

Gene ID	Gene	Sequence
GRMZM2G035843	<i>ZmCPK14</i>	F: 5'-CTAATTCCATATGATGCAGCCGGACC-3' R: 5'-GCGAGTCGACCTAGGTTTTGCTG-3'
GRMZM2G047486	<i>ZmCPK15</i>	F: 5'-GGAATTCCATATGATGCAGCCGGAC-3' R: 5'-AGACGTCGACCTAGGTTTTGCTGG-3'
GRMZM2G463464	<i>ZmCPK17</i>	F: 5'-CGGGATCCATGCAGCCGGACC-3' R: 5'-AACTGCAGCTAGGTCTCGGTGGGC-3'
GRMZM2G058305	<i>ZmCPK22</i>	F: 5'-CGAATTCATGGGCGGCCGCG-3' R: 5'-CGGGATCCTTAAAACATGCGCCTCCGATTTG-3'
GRMZM2G154489	<i>ZmCPK26</i>	F: 5'-GGAATTCATGGGGCAGTGTTGCAGC-3' R: 5'-ACGCGTCGACCTACTTGAGCCTCATT-3'

GRMZM2G168706	<i>ZmCPK28</i>	F: 5'-CGGAATTCATGGGGCAGTGTTGTAG-3' R: 5'-GCGAGTCGACCTACTTGAGCCTCA-3'
GRMZM2G028086	<i>ZmCPK36</i>	F: 5'-CTAATTCCATATGATGGGCAACTGCT-3' R: 5'-CGGAATTCCTACCGTGTACTCGTC-3'
GRMZM2G099425	<i>ZmCPK37</i>	F: 5'-CCGGATCCATGGGCAACTGCT-3' R: 5'-GCCTGCAGCTACTGCGTACTCT-3'
GRMZM2G365035	<i>ZmCPK38</i>	F: 5'-CGAATTCATGGGCCTCTGCTCCTCC-3' R: 5'-ACGCGTCGACCTATGACTTGCGAACA-3'
GRMZM2G102255	<i>ZmPP2C1</i>	F: CCCATATGATGACCCACCACTACCCCCCGA R: CGGGATCCTTATGCTCTGCTCTTGATCTTCCTA
GRMZM2G059453	<i>ZmPP2C3</i>	F: TGAATTCATGGCCGAGATCTGCTGCGAG R: GGGATCCTTCGCTCCGAGAATCATATGC
GRMZM2G177386	<i>ZmPP2C4</i>	F: CCCATATGATGGCGGCGGCGATGTGCGTGG R: CGGAATTCTCAAATATCGGTCCCCAATCGATCT
GRMZM2G437575	<i>ZmPP2C5</i>	F: CCCATATGATGGCATGGTTCCTGCAAGTGG R: CGGAATTCTCAGCTCAGCTCTACTGTGATGGAC
GRMZM2G383807	<i>ZmPP2C7</i>	F: CGGAATTCATGGAGGACCTCGCCCC R: GCCCTAGGTTATGTTCTGCTCTTGAACCTTCTA
GRMZM2G019819	<i>ZmPP2C8</i>	F: CCCATATGATGACCAGCGCCGGCGTCAAC R: CGGAATTCTCACTCCCTGTGCTTGAGGTCAACG
GRMZM2G122228	<i>ZmPP2C9</i>	F: CCCATATGGAAGAGATGAGCAGCAGTGA R: CGGAATTCCTACAGACTACGTCCTACCATTCTG
GRMZM2G001243	<i>ZmPP2C10</i>	F: CCCATATGATGGCGGCGGCGGCGATCTGC R: CGGAATTCCTATAATCTACATCCCACTTAAAAA
GRMZM2G035809	<i>ZmSnRK2.1</i>	F: CCCATATGGGATGGAGCGGTACGAGGTGAT R: CGGGATCCCGCCTCACACAGTCACACTGCACA
GRMZM2G056732	<i>ZmSnRK2.2</i>	F: CCCATATGGGATGGAGAGGTACGAGGTGAT R: CGGGATCCCGTCACAAGGCACATACAAAGTC
GRMZM2G110908	<i>ZmSnRK2.5</i>	F: CCCATATGGGATGGACAAGTACGAGCCC

		R: <u>CCCTCGAGGG</u> ATACTAAGAGTCAGATTG
GRMZM2G155593	<i>ZmSnRK2.7</i>	F: <u>CGCATATGGAGAAACACGAGCTATTGA</u> R: <u>ATGAATTCTTAACAAGAAAGATGAAAC</u>
GRMZM2G063961	<i>ZmSnRK2.11</i>	F: <u>CCCATATGGGATGGACAAGTACGAGGCT</u> R: <u>CGGGATCCCGAGGCAGCATTAGATGTG</u>

Supplementary Table S4 Primers for pGADT7 vectors construction of *ZmCDPK* genes

Gene	Sequence	Restriction Site	Buffer	Restriction Temperature	Annealing Temperature
<i>ZmCPK14</i>	F: 5'-GGAATTC <u>CATATG</u> ATGCAGCCGGAC-3' R: 5'-TCCCCCGGGCTAGGTTTGGCT-3'	<i>Nde</i> I <i>Sma</i> I	1×T+BSA	30 °C	61.2 °C 61.5 °C
<i>ZmCPK15</i>	F: 5'-AGAATTC <u>CATATG</u> ATGCAGCCGGAC-3' R: 5'-TAACCCGGGCTAGGTTTGGCT-3'	<i>Nde</i> I <i>Sma</i> I	1×T+BSA	30 °C	59.6 °C 57.6 °C
<i>ZmCPK17</i>	F: 5'- <u>CGAATTC</u> ATGCAGCCGGACC-3' R: 5'-CGGGATCCCTAGGTCTCGGTG-3'	<i>Eco</i> RI <i>Bam</i> HI	1×K	30 °C	59.5 °C 63.4 °C
<i>ZmCPK22</i>	F: 5'- <u>CGAATTC</u> ATGGGCGGCCGCG-3' R: 5'-CGGGATCCTTAAACATGCGCCTCCGATTG-3'	<i>Eco</i> RI <i>Bam</i> HI	1×K	30 °C	63.6 °C 64.9 °C
<i>ZmCPK26</i>	F: 5'- <u>CGAATTC</u> ATGGGGCAGTGTTG-3' R: 5'-CGGGATCCCTACTTGAGCCTCAT-3'	<i>Eco</i> RI <i>Bam</i> HI	1×K	30 °C	57.6 °C 61.3 °C
<i>ZmCPK28</i>	F: 5'-GGAATTC <u>CATATG</u> ATGGGGCAGTG-3' R: 5'- <u>CGAATTC</u> CTACTTGAGCCTCATTGGC-3'	<i>Nde</i> I <i>Eco</i> RI	1×H	37 °C	59.3 °C 61.2 °C
<i>ZmCPK34</i>	F: 5'-GGAATTC <u>CATATG</u> ATGGGCAACTG-3' R: 5'- <u>CGAATTC</u> CTACCGTGTA CTGTCAT-3'	<i>Nde</i> I <i>Eco</i> RI	1×H	37 °C	57.9 °C 59.6 °C
<i>ZmCPK35</i>	F: 5'- <u>CGAATTC</u> ATGGGCAACTGCTGC-3' R: 5'-AGGGATCCCTACTGCGTACTCTCC-3'	<i>Eco</i> RI <i>Bam</i> HI	1×K	30 °C	59.5 °C 63.0 °C
<i>ZmCPK36</i>	F: 5'-GTAATTC <u>CATATG</u> ATGGGCCTCTGCTCC-3' R: 5'- <u>CGAATTC</u> CTATGACTTGCGAACACCCC-3'	<i>Nde</i> I <i>Eco</i> RI	1×H	37°C	62.5 °C 62.6 °C
<i>ZmSnRK2.1</i>	F: 5'- <u>CCCATATGGGATGGAGCGGTACGAGGTGAT</u> -3' R: 5'- <u>CGGGATCCCGCCTCACACAGTCACACTGCACA</u> -3'	<i>Nde</i> I <i>Bam</i> HI	1×K	30 °C	58.5 °C 62.0 °C
<i>ZmSnRK2.2</i>	F: 5'- <u>CCCATATGGGATGGAGAGGTACGAGGTGAT</u> -3' R: 5'- <u>CGGGATCCCGTCACAAGGCACATACAAAGTC</u> -3'	<i>Nde</i> I <i>Bam</i> HI	1×K	30 °C	59.5 °C 61.0 °C
<i>ZmSnRK2.5</i>	F: 5'- <u>CCCATATGGGATGGACAAGTACGAGCCC</u> -3' R: 5'-CCCT <u>CGAGGG</u> ATACTAAGAGTCAGATTGG-3'	<i>Nde</i> I <i>Sml</i> I	1×K	30 °C	57.5 °C 63.0 °C
<i>ZmSnRK2.7</i>	F: 5'- <u>G</u> <u>CATATGGAGAAACACGAGCTATTGA</u> -3' R: 5'- <u>TGAATTC</u> TTAACAAGAAAGATGAAAC-3'	<i>Nde</i> I <i>Eco</i> RI	1×H	37 °C	58.9 °C 59.6 °C
<i>ZmSnRK2.11</i>	F: 5'- <u>CCCATATGGGATGGACAAGTACGAGGCT</u> -3' R: 5'-CGGGATCCCGAGGCAGCATTAGATGTG-3'	<i>Nde</i> I <i>Bam</i> HI	1×K	30 °C	59.5 °C 63.0 °C

Supplementary Table S5 Primers for pGBKT7 vector construction of *ZmCDPK* genes

Gene	Sequence	Restriction sites	Buffer	Restriction temperature	Annealing temperature
<i>ZmCPK14</i>	F: 5'-CTAATTCCATATGATGCAGCCGGACC-3' R: 5'-GCGAGTCGACCTAGGTTTTGCTG-3'	<i>Nde</i> I <i>Sal</i> I	1×H	37 °C	68.9 °C 67.9 °C
<i>ZmCPK15</i>	F: 5'-GGAATTCATATGATGCAGCCGGAC-3' R: 5'-AGACGTCGACCTAGGTTTTGCTGG-3'	<i>Nde</i> I <i>Sal</i> I	1×H	37 °C	61.2 °C 61.3 °C
<i>ZmCPK17</i>	F: 5'-CGGGATCCATGCAGCCGGACC-3' R: 5'-AACTGCAGCTAGGTCTCGGTGGGC-3'	<i>Bam</i> HI <i>Pst</i> I	1×K	30 °C	73.1 °C 73.8 °C
<i>ZmCPK22</i>	F: 5'-CGAATTCATGGGCGGCCGCG-3' R: 5'-CGGGATCCTTAAAACATGCGCCTCCGATTG-3'	<i>Eco</i> RI <i>Bam</i> HI	1×K	30 °C	63.6 °C 64.9 °C
<i>ZmCPK26</i>	F: 5'-GGAATTCATGGGGCAGTGTTGCAGC-3' R: 5'-ACGCGTCGACCTACTTGAGCCTCATT-3'	<i>Eco</i> RI <i>Sal</i> I	1×H	37 °C	72.4 °C 72.8 °C
<i>ZmCPK28</i>	F: 5'-CGGAATTCATGGGGCAGTGTTGTAG-3' R: 5'-GCGAGTCGACCTACTTGAGCCTCA-3'	<i>Eco</i> RI <i>Sal</i> I	1×H	37 °C	68.4 °C 68.8 °C
<i>ZmCPK34</i>	F: 5'-CTAATTCCATATGATGGGCAACTGCT-3' R: 5'-CGGAATTCCTACCGTGTACTCGTC-3'	<i>Nde</i> I <i>Eco</i> RI	1×H	37 °C	65.0 °C 67.0 °C
<i>ZmCPK35</i>	F: 5'-CCGGATCCATGGGCAACTGCT-3' R: 5'-GCCTGCAGCTACTGCGTACTCT-3'	<i>Bam</i> HI <i>Pst</i> I	1×K	30 °C	68.7 °C 68.6 °C
<i>ZmCPK36</i>	F: 5'-CGAATTCATGGGCCTCTGCTCCTCC-3' R: 5'-ACGCGTCGACCTATGACTTGCGAACA-3'	<i>Eco</i> RI <i>Sal</i> I	1×H	37 °C	64.5 °C 62.8 °C
<i>ZmPP2C1</i>	F: 5'-CCCATATGATGACCCACCACTACCCCCCGA R: 5'-CGGGATCCTTATGCTCTGCTCTTGATCTTCCTA	<i>Nde</i> I <i>Bam</i> HI	1×K	30 °C	59.5 °C 63.0 °C
<i>ZmPP2C3</i>	F: 5'-TGAATTCATGGCCGAGATCTGCTGCGAG-3' R: 5'-GGGATCCTTCGCTCCGAGAATCATATGC-3'	<i>Eco</i> RI <i>Bam</i> HI	1×K	30 °C	62.6 °C 63.9 °C
<i>ZmPP2C5</i>	F: 5'-CCCATATGATGGCATGGTTCCTGCAAGTGG-3' R: 5'- CGGAATTCTCAGCTCAGCTCTACTGTGATGGAC-3'	<i>Nde</i> I <i>Eco</i> RI	1×H	37 °C	64.0 °C 62.0 °C
<i>ZmPP2C7</i>	F: 5'-CGGAATTCATGGAGGACCTCGCCCC-3' R: 5'-GCCCTAGGTTATGTTCTGCTCTTGAACCTTCTA-3'	<i>Eco</i> RI <i>StyI</i>	1×H	37 °C	59.0 °C 61.0 °C
<i>ZmPP2C8</i>	F: 5'-CCCATATGATGACCAGCGCCGGCGTCAAC-3' R: 5'- CGGAATTCTCACTCCCTGTGCTTGAGGTCAACG-3'	<i>Nde</i> I <i>Eco</i> RI	1×H	37 °C	64.5 °C 63.0 °C
<i>ZmPP2C9</i>	F: 5'-CCCATATGGAAGAGATGAGCAGCAGTGA-3' R: 5'- CGGAATTCCTACAGACTACGTCTACCATTTCTG-3'	<i>Nde</i> I <i>Eco</i> RI	1×H	37 °C	62.0 °C 64.0 °C
<i>ZmPP2C10</i>	F: 5'-CCCATATGATGGCGGCGGCGGCGATCTGC-3' R: 5'- CGGAATTCCTATAATCTACATCCCACTTAAAAA-3'	<i>Nde</i> I <i>Eco</i> RI	1×H	37 °C	60.0 °C 62.0 °C

Supplementary Table S6. Primers for pSAT6A-cEYFP-N1 vector construction of clade A *ZmPP2C* genes

Gene	Accession Number	Sequence
<i>ZmPP2C1</i>	GRMZM2G102255	F: 5'-tttacgaacgatagagatctATGGACGACCTCACCGTGGGGG-3' R: 5'-gactgcagaattcgaagcttTGCTCTGCTCTTGATCTTCCTAR-3'
<i>ZmPP2C3</i>	GRMZM2G059453	F: 5'-cgagctcaagcttcgaattcATGGCCGAGATCTGCTGCGAGG-3' R: 5'-ctgcacgctgccaggatccTATGCCCCGGCGGAGATCCACG-3'
<i>ZmPP2C4</i>	GRMZM2G177386	F: 5'-tttacgaacgatagagatctATGGCGGCGGCGATGTGCGTGG-3' R: 5'-taccgtcgactgcagaattcTGAGTTGCTCTTGGCCTTCTTT-3'
<i>ZmPP2C5</i>	GRMZM2G437575	F: 5'-tttacgaacgatagagatctATGGTCGGCCGGATGGAGCGGC-3' R: 5'-taccgtcgactgcagaattcGCAGCGGAAACGGATGACAATG-3'
<i>ZmPP2C7</i>	GRMZM2G383807	F: 5'-tttacgaacgatagagatctATGGAGGACCTCGCCCCGGGGG-3' R: 5'-taccgtcgactgcagaattcTTATGTTCTGCTCTTGAACCTT-3'
<i>ZmPP2C8</i>	GRMZM2G019819	F: 5'-tttacgaacgatagagatctATGTCGGCGTCGCGGAGCGGGA-3' R: 5'-taccgtcgactgcagaattcTTCATTGACCCGCTATTTCTT-3'
<i>ZmPP2C9</i>	GRMZM2G122228	F: 5'-tttacgaacgatagagatctATGAGCAGCAGTGAGGCTAGCA-3' R: 5'-taccgtcgactgcagaattcCGTCCTACCATCTGTCTACCA-3'
<i>ZmPP2C10</i>	GRMZM2G001243	F: 5'-tttacgaacgatagagatctATGGCGGCGGCGGCGATCTGCG-3' R: 5'-taccgtcgactgcagaattcCATCCCACTTAAAAAGGGGAAA-3'

Note: The lowercase and uppercase letters stand for sequences homologous to pSAT6A-cEYFP-N1_vector and the clade A *ZmPP2C* genes, respectively.

Supplementary Table S7 Primers for pSAT6-nEYFP-N1 vector construction of *ZmCPK* genes

Gene	Accession Number	Sequence
<i>ZmCPK15</i>	GRMZM2G047486	F: 5'-gatagccatggtccggactcagatctATGCAGCCGGACC-3' R: 5'-ccgggcccgcggtaccgGTCTCGGTGGGC-3'
<i>ZmCPK36</i>	GRMZM2G028086	F: 5'-gatagccatggtccggactcagatctATGGGCAACTGCT-3' R: 5'-ccgggcccgcggtacccCGTGTACTCGTC-3'
<i>ZmCPK38</i>	GRMZM2G365035	F: 5'-gatagccatggtccggactcagatctATGGGCCTCTGCTCCTCC-3' R: 5'-ccgggcccgcggtACCTGACTTGCGAACA-3'

Note: The lowercase and uppercase letters stand for sequences homologous to pSAT6-nEYFP-N1_vector and *ZmCPK* genes, respectively.

Supplementary Table S8: Members of ZmMAPK family.

No.	Gene	Accession Number	No.	Gene	Accession Number
1	<i>ZmMPK1</i>	GRMZM2G123886	12	<i>ZmMPK12</i>	GRMZM2G062761
2	<i>ZmMPK2</i>	GRMZM2G062914	13	<i>ZmMPK13</i>	GRMZM2G163861
3	<i>ZmMPK3</i>	GRMZM2G017792	14	<i>ZmMPK14</i>	GRMZM2G131334
4	<i>ZmMPK4</i>	GRMZM2G053987	15	<i>ZmMPK15</i>	GRMZM2G306028
5	<i>ZmMPK5</i>	GRMZM2G020216	16	<i>ZmMPK16</i>	GRMZM2G034052
6	<i>ZmMPK6</i>	GRMZM2G089484	17	<i>ZmMPK17</i>	GRMZM2G374088
7	<i>ZmMPK7</i>	GRMZM2G002100	18	<i>ZmMPK18</i>	GRMZM2G122335
8	<i>ZmMPK8</i>	GRMZM2G048455	19	<i>ZmMPK19</i>	GRMZM2G00784
9	<i>ZmMPK9</i>	GRMZM2G135904	20	<i>SIMK</i>	GRMZM2G127141
11	<i>ZmMPK11</i>	GRMZM2G375975			