

Supplementary Materials

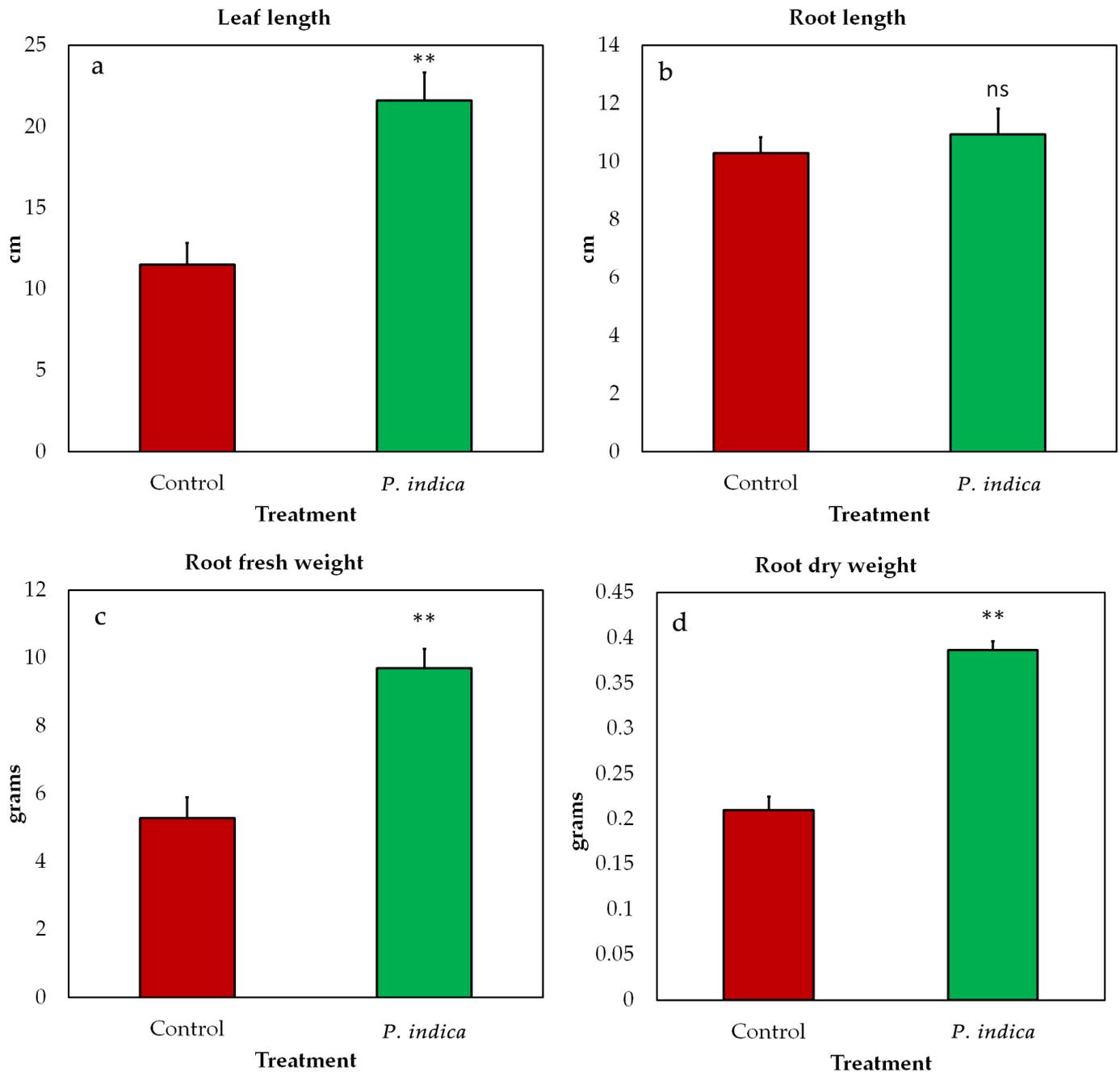


Figure S1. Effects of *P. indica* treatment on onion growth parameters. Leaf length (a), root length (b), fresh (c) and dry (d) weights were measured at 60 days post-treatment and compared with untreated control. Values are expressed as the average of three biological replicates, each consisting of three (a, b) or five plants pooled together (c, d). Statistically significant differences were assessed by Student's t-test at a 5% significance level. *p*-value significance codes: '**' < 0.01, not significant. Error bars indicate standard error of the mean.



Figure S2. Reduction of *Stemphylium* leaf blight disease symptoms on onion treated with *P. indica*, compared to the untreated control, as observed 5 days after inoculation with *S. vesicarium*.

Table S1. Results of statistical analysis of the effects of *P. indica* treatment on onion growth parameters.

| Treatment | Parameter | df | t-value | p-value | Mean | Lower CI | Upper CI | Significance |
|-----------------------------|-------------------|------|---------|---------|----------------|----------|----------|--------------|
| Control <i>P. indica</i> | Root length | 4.00 | -0.60 | 0.580 | 10.30 10.93 | -3.56 | 2.29 | ns |
| Control <i>P. indica</i> | Leaf length | 4.00 | -4.62 | 0.010 | 11.57 21.60 | -16.07 | -4.00 | ** |
| Control <i>P. indica</i> | Root fresh weight | 4.00 | -5.18 | 0.007 | 5.28 9.70 | -6.79 | -2.05 | ** |
| Control <i>P. indica</i> | Root dry weight | 4.00 | -10.07 | 0.001 | 0.21 0.39 | -0.23 | -0.13 | *** |

Statistically significant differences were assessed by Student's t-test at a 5% significance level. *p*-value significance codes: '***' < 0.001, '**' < 0.01, 'ns' not significant. *df*: degrees of freedom; CI: confidence interval.

Table S2. Results of statistical analysis of the effects of *P. indica* treatment on Stemphylium leaf blight PDI, in greenhouse conditions.

| | dpi | df | t-value | p-value | Mean | Lower CI | Upper CI | Significance |
|--|------|------|---------|----------|----------------|----------|----------|--------------|
| Untreated/ <i>S. vesicarium</i> <i>P. indica</i> / <i>S. vesicarium</i> | 1.00 | 4.00 | 0.00 | 1.00E+00 | 6.67 6.67 | -8.28 | -8.28 | ns |
| Untreated/ <i>S. vesicarium</i> <i>P. indica</i> / <i>S. vesicarium</i> | 3.00 | 4.00 | 4.29 | 1.28E-02 | 26.00 12.00 | 4.93 | 23.07 | * |
| Untreated/ <i>S. vesicarium</i> <i>P. indica</i> / <i>S. vesicarium</i> | 5.00 | 4.00 | 7.34 | 1.83E-03 | 40.00 18.67 | 13.27 | 13.27 | ** |

The percent disease index (PDI) was scored at 1, 3, 5 days post-inoculation with *S. vesicarium* and compared between *P. indica*-treated and untreated plants. Values are expressed as the average of three biological replicates, each consisting of ten plants pooled together. Statistically significant differences were assessed by Student's t-test at a 5% significance level. *p*-value significance codes: '***' < 0.01, '**' < 0.05, 'ns' not significant. dpi: days post-inoculation; *df*: degrees of freedom; CI: confidence interval.

Table S3. Results of ANOVA statistical analysis of the effects of *P. indica* treatment on Stemphylium leaf blight AUDPC, in greenhouse conditions.

| | df | t-value | p-value | Mean | Lower CI | Upper CI | Significance |
|--|------|---------|---------|----------------|----------|----------|--------------|
| Untreated/ <i>S. vesicarium</i> <i>P. indica</i> / <i>S. vesicarium</i> | 4.00 | 5.48 | 0.005 | 89.67 37.33 | 25.82 | 78.85 | ** |

The area under disease progress curve (AUDPC) was calculated based on the percent disease index (PDI) scored at 1, 3, 5 days post-inoculation with *S. vesicarium* and compared between *P. indica*-treated and untreated plants. Values are expressed as the average of three biological replicates, each consisting of ten plants pooled together. Statistically significant differences were assessed by Student's t-test at a 5% significance level. *p*-value significance codes: '***' < 0.01, 'ns' not significant. dpi: days post-inoculation; *df*: degrees of freedom; CI: confidence interval.

Table S4. Results of ANOVA statistical analysis of the effects of *P. indica* treatment on Stemphylium leaf blight PDI, in field conditions.

| | dat | Year | df | Sum of Squares | Mean Squares | F-value | p-value | Significance |
|-----------|-----|------|-------|----------------|--------------|---------|----------|--------------|
| Treatment | 30 | 2018 | 4.00 | 60.27 | 15.07 | 1.66 | 2.34E-01 | ns |
| Residuals | | | 10.00 | 90.67 | 9.07 | | | |
| Treatment | 45 | 2018 | 4.00 | 553.60 | 138.40 | 13.31 | 5.15E-04 | *** |
| Residuals | | | 10.00 | 104.00 | 10.40 | | | |
| Treatment | 60 | 2018 | 4.00 | 1310.90 | 327.70 | 30.73 | 1.36E-05 | *** |
| Residuals | | | 10.00 | 106.70 | 10.70 | | | |
| Treatment | 75 | 2018 | 4.00 | 1857.60 | 464.40 | 39.58 | 4.22E-06 | *** |
| Residuals | | | 10.00 | 117.30 | 11.70 | | | |
| Treatment | 30 | 2019 | 4.00 | 252.27 | 63.07 | 12.45 | 6.76E-04 | *** |
| Residuals | | | 10.00 | 50.67 | 5.07 | | | |
| Treatment | 45 | 2019 | 4.00 | 1140.30 | 285.07 | 48.59 | 1.61E-06 | *** |
| Residuals | | | 10.00 | 58.70 | 5.87 | | | |
| Treatment | 60 | 2019 | 4.00 | 1906.70 | 476.70 | 48.31 | 1.66E-06 | *** |
| Residuals | | | 10.00 | 98.70 | 9.90 | | | |
| Treatment | 75 | 2019 | 4.00 | 2875.70 | 718.90 | 62.70 | 4.81E-07 | *** |
| Residuals | | | 10.00 | 114.70 | 11.50 | | | |

Stemphylium leaf blight percent disease index (PDI) was scored at 30, 45, 60, 75 days after field transplanting and compared among plants treated with *P. indica*, treated with three different fungicides or untreated. Values for each year are expressed as the average of three biological replicates, each consisting of ten plants pooled together. Statistically significant differences were assessed by one-way analysis of variance (ANOVA). *p*-value significance codes: '****' < 0.001, 'ns' not significant. dat: days after transplanting; *df*: degrees of freedom.

Table S5. Results of ANOVA statistical analysis of the effects of *P. indica* treatment on Stemphylium leaf blight AUDPC, in field conditions.

| | Year | Df | Sum of Squares | Mean Squares | F-value | p-value | Significance |
|-----------|------|-------|----------------|--------------|---------|----------|--------------|
| Treatment | 2018 | 4.00 | 3614385.00 | 903596.00 | 18.68 | 1.24E-04 | *** |
| Residuals | | 10.00 | 483863.00 | 48386.00 | | | |
| Treatment | 2019 | 4.00 | 4480440.00 | 1120110.00 | 33.03 | 9.74E-06 | *** |
| Residuals | | 10.00 | 339113.00 | 33911.00 | | | |

Stemphylium leaf blight area under disease progress curve (AUDPC) was calculated based on the percent disease index (PDI) scored at 30, 45, 60, 75 days after field transplanting and compared among plants treated with *P. indica*, treated with three different fungicides or untreated. Values for each year are expressed as the average of three biological replicates, each consisting of ten plants pooled together. Statistically significant differences were assessed by one-way analysis of variance (ANOVA). *p*-value significance codes: '****' < 0.001. *df*: degrees of freedom.

Table S6. Results of the linear model analysis of the factors affecting *Stemphylium* leaf blight PDI, in field conditions.

| | <i>df</i> | Sum of Squares | Mean Squares | F-value | <i>p</i> -value | Significance |
|----------------------|-----------|----------------|--------------|---------|-----------------|--------------|
| Treatment | 4 | 6487 | 1621.7 | 9.23 | 1.16E-06 | *** |
| Year | 1 | 146 | 146 | 0.831 | 0.363 | ns |
| Biological Replicate | 1 | 144 | 144 | 0.82 | 0.367 | ns |
| Residuals | 143 | 25125 | 175.7 | | | |

Stemphylium leaf blight percent disease index (PDI) was scored at 30, 45, 60, 75 days after field transplanting and compared among plants treated with *P. indica*, treated with three different fungicides or untreated. The linear model (lm) “PDI ~ Treatment + Year + Biological Replicate” was established to evaluate statistically significant fixed or random effects of the different factors. *p*-value significance codes: ‘***’ < 0.001, ‘ns’ not significant. *df*: degrees of freedom.

Table S7. Results of the linear model analysis of the factors affecting *Stemphylium* leaf blight AUDPC, in field conditions.

| | <i>df</i> | Sum of Squares | Mean Squares | F-value | <i>p</i> -value | Significance |
|----------------------|-----------|----------------|--------------|---------|-----------------|--------------|
| Treatment | 4 | 7979651 | 1994913 | 55.781 | 3.35E-11 | *** |
| Year | 1 | 9720 | 9720 | 0.272 | 0.607 | ns |
| Biological Replicate | 2 | 151361 | 75681 | 2.116 | 0.144 | ns |
| Residuals | 22 | 786787 | 35763 | | | |

Stemphylium leaf blight area under disease progress curve (AUDPC) was calculated based on the percent disease index (PDI) scored at 30, 45, 60, 75 days after field transplanting and compared among plants treated with *P. indica*, treated with three different fungicides or untreated. The linear model (lm) “AUDPC ~ Treatment + Year + Biological Replicate” was established to evaluate statistically significant fixed or random effects of the different factors. *p*-value significance codes: ‘***’ < 0.001, ‘ns’ not significant. *df*: degrees of freedom.

Table S8. Results of ANOVA statistical analysis of the effects of *P. indica* treatment and Stemphylium leaf blight disease on onion biochemical response.

| | Enzyme | dpi | df | Sum of Squares | Mean Squares | F-value | p-value | Significance |
|-----------|-----------------------------|-----|----|----------------|--------------|---------|----------|--------------|
| Treatment | Hydrogen peroxide | 1 | 3 | 44927.00 | 14975.70 | 8.19 | 8.04E-03 | ** |
| Residuals | | | 8 | 14636.00 | 1829.40 | | | |
| Treatment | Hydrogen peroxide | 3 | 3 | 131410.00 | 43803.00 | 149.34 | 2.32E-07 | *** |
| Residuals | | | 8 | 2347.00 | 293.00 | | | |
| Treatment | Hydrogen peroxide | 5 | 3 | 275123.00 | 91708.00 | 352.75 | 7.78E-09 | *** |
| Residuals | | | 8 | 2080.00 | 260.00 | | | |
| Treatment | Lipid peroxidation | 1 | 3 | 102.71 | 34.24 | 6.29 | 1.69E-02 | * |
| Residuals | | | 8 | 43.57 | 5.45 | | | |
| Treatment | Lipid peroxidation | 3 | 3 | 591.22 | 197.07 | 277.53 | 2.01E-08 | *** |
| Residuals | | | 8 | 5.68 | 0.71 | | | |
| Treatment | Lipid peroxidation | 5 | 3 | 1323.62 | 441.21 | 130.87 | 3.88E-07 | *** |
| Residuals | | | 8 | 26.97 | 3.37 | | | |
| Treatment | Catalase | 1 | 3 | 35.46 | 11.82 | 10.34 | 3.97E-03 | ** |
| Residuals | | | 8 | 9.14 | 1.14 | | | |
| Treatment | Catalase | 3 | 3 | 32.19 | 10.73 | 36.67 | 5.05E-05 | *** |
| Residuals | | | 8 | 2.34 | 0.29 | | | |
| Treatment | Catalase | 5 | 3 | 26.45 | 8.82 | 13.03 | 1.91E-03 | ** |
| Residuals | | | 8 | 5.41 | 0.68 | | | |
| Treatment | Ascorbate peroxidase | 1 | 3 | 29463.70 | 9821.20 | 17.98 | 6.48E-04 | *** |
| Residuals | | | 8 | 4369.80 | 546.20 | | | |
| Treatment | Ascorbate peroxidase | 3 | 3 | 89546.00 | 29848.50 | 47.24 | 1.96E-05 | *** |
| Residuals | | | 8 | 5055.00 | 631.80 | | | |
| Treatment | Ascorbate peroxidase | 5 | 3 | 144912.00 | 48304.00 | 44.95 | 2.37E-05 | *** |
| Residuals | | | 8 | 8598.00 | 1075.00 | | | |
| Treatment | Guaiacol peroxidase | 1 | 3 | 2291.49 | 763.83 | 16.99 | 7.87E-04 | *** |
| Residuals | | | 8 | 359.61 | 44.95 | | | |
| Treatment | Guaiacol peroxidase | 3 | 3 | 9881.40 | 3293.80 | 105.76 | 8.92E-07 | *** |
| Residuals | | | 8 | 249.20 | 31.10 | | | |
| Treatment | Guaiacol peroxidase | 5 | 3 | 19332.60 | 6444.20 | 172.48 | 1.31E-07 | *** |
| Residuals | | | 8 | 298.90 | 37.40 | | | |
| Treatment | Superoxide dismutase | 1 | 3 | 47665.00 | 15888.20 | 29.90 | 1.07E-04 | *** |
| Residuals | | | 8 | 4252.00 | 531.50 | | | |
| Treatment | Superoxide dismutase | 3 | 3 | 62303.00 | 20767.70 | 37.32 | 4.74E-05 | *** |
| Residuals | | | 8 | 4452.00 | 556.50 | | | |
| Treatment | Superoxide dismutase | 5 | 3 | 71625.00 | 23875.00 | 48.18 | 1.82E-05 | *** |
| Residuals | | | 8 | 3965.00 | 495.60 | | | |
| Treatment | Phenylalanine ammonia-lyase | 1 | 3 | 1.81 | 0.60 | 32.61 | 7.79E-05 | *** |
| Residuals | | | 8 | | | | | |

| | | | | | | | | |
|-----------|-----------------------------|---|---|-------|-------|-------|--------|-----|
| Residuals | | | 8 | 0.15 | 0.02 | | | |
| Treatment | | | | | | | 1.85E- | |
| t | Phenylalanine ammonia-lyase | 3 | 3 | 32.16 | 10.72 | 25.70 | 04 | *** |
| Residuals | | | 8 | 3.34 | 0.42 | | | |
| Treatment | | | | | | | 1.07E- | |
| t | Phenylalanine ammonia-lyase | 5 | 3 | 60.17 | 20.06 | 29.89 | 04 | *** |
| Residuals | | | 8 | 5.37 | 0.67 | | 8.04E- | |
| | | | | | | | 03 | |

The biochemical response of selected *A. cepa* enzymes was evaluated at 1, 3, 5 days after *S. vesicarium* or mock inoculation and compared between *P. indica*-treated or untreated plants. Values are expressed as the average of three biological replicates, each consisting of three plants pooled together. Statistically significant differences were assessed by one-way analysis of variance (ANOVA). *p*-value significance codes: '***' < 0.001, '**' < 0.01, '*' < 0.05. dpi: days post-inoculation; *df*: degrees of freedom.

Table S9. Results of the linear model analysis of the factors affecting qRT-PCR expression analysis of onion defense-related genes.

| | <i>df</i> | Sum of Squares | Mean Squares | F-value | <i>p</i> -value | Significance |
|------------------------|-----------|----------------|--------------|---------|-----------------|--------------|
| Treatment | 3 | 109.8 | 36.61 | 4.731 | 0.00332 | ** |
| Experimental Replicate | 1 | 0.10 | 0.10 | 0.013 | 0.90904 | ns |
| Technical Replicate | 1 | 0.0 | 0.00 | 0.000 | 1.00000 | ns |
| Residuals | 186 | 1439.3 | 7.74 | | | |

Relative expression of selected *A. cepa* genes was evaluated at 5 days after *S. vesicarium* or mock inoculation and compared between *P. indica*-treated or untreated plants (factor "Treatment"). The experiment was repeated twice, relying on two independent sets of leaf samples (factor "Experimental replicate"). Each reaction was performed in triplicate wells (factor "Technical replicate"). The linear model (lm) "Relative expression ~ Treatment + Experimental replicate + Technical replicate" was established to evaluate statistically significant fixed or random effects of the different factors. *p*-value significance codes: '***' < 0.01, 'ns' not significant. *df*: degrees of freedom.

Table S10. Results of ANOVA statistical analysis of the effects of *P. indica* treatment and Stemphylium leaf blight disease on onion defense-related genes.

| | Gene | Df | Sum of Squares | Mean Squares | F-value | <i>p</i> -value | Significance |
|-----------|-----------------|----|----------------|--------------|---------|-----------------|--------------|
| Treatment | <i>AcLOX1</i> | 3 | 5.90 | 1.97 | 8.89 | 6.30E-03 | ** |
| Residuals | | 8 | 1.77 | 0.22 | | | |
| Treatment | <i>AcLOX2</i> | 3 | 18.43 | 6.14 | 34.30 | 6.47E-05 | *** |
| Residuals | | 8 | 1.43 | 0.18 | | | |
| Treatment | <i>AcWRKY1</i> | 3 | 6.67 | 2.22 | 68.90 | 4.67E-06 | *** |
| Residuals | | 8 | 0.26 | 0.03 | | | |
| Treatment | <i>AcWRKY70</i> | 3 | 6.07 | 2.02 | 11.23 | 3.07E-03 | ** |
| Residuals | | 8 | 1.44 | 0.18 | | | |
| Treatment | <i>AcPAL1</i> | 3 | 7.04 | 2.35 | 24.77 | 2.11E-04 | *** |
| Residuals | | 8 | 0.76 | 0.09 | | | |
| Treatment | <i>AcCHI</i> | 3 | 28.61 | 9.54 | 249.20 | 3.08E-08 | *** |
| Residuals | | 8 | 0.31 | 0.04 | | | |
| Treatment | <i>AcGST</i> | 3 | 13.20 | 4.40 | 10.44 | 3.86E-03 | ** |
| Residuals | | 8 | 3.37 | 0.42 | | | |

Relative expression of selected *A. cepa* genes was evaluated at 5 days after *S. vesicarium* or mock inoculation and compared between *P. indica*-treated or untreated plants. Each sample was collected from five plants pooled together. Data refer to the most representative of two independent repeated experiments. Each reaction was performed in triplicate wells. Statistically significant differences were assessed by one-way analysis of variance (ANOVA). *p*-value significance codes: '***' < 0.001, '**' < 0.01, '.' *p* < 0.05. dpi: days post-inoculation; *df*: degrees of freedom.

Table S11. Onion target genes and respective primer sets used for qRT-PCR expression analysis.

| Target gene | GenBank Accession | | Primer Sequence | Amplicon Size (bp) |
|-----------------|-------------------|-----|-----------------------------|--------------------|
| <i>AcLOX1</i> | KU363822.1 | Fwd | 5'-AGGCACGGCAGTGTTAATGA -3' | 204 |
| | | Rev | 5'-CACCAGCCGCTACAGATGAT-3' | |
| <i>AcLOX2</i> | KX427168.1 | Fwd | 5'-CGAGCAACCGATGGCAAAAT-3' | 187 |
| | | Rev | 5'-TTCCGGTGATGAACTGCTCC-3' | |
| <i>AcCHI</i> | KM114296.1 | Fwd | 5'-CCTACGCCCAACAAAGTG-3' | 192 |
| | | Rev | 5'-ATACTCCTGATCCTCCTCC-3' | |
| <i>AcGST</i> | AB300334.1 | Fwd | 5'-TCGTGAGAGTGATTGCGGTT-3' | 210 |
| | | Rev | 5'-CGCAGGTAGGAGGTCTGTTC-3' | |
| <i>AcPAL1</i> | KF421110.1 | Fwd | 5'-AGGTGGAAGTTGTAAGGGCG-3' | 187 |
| | | Rev | 5'-CCATTGCAAACCGCCTCAA-3' | |
| <i>AcWRKY1</i> | KY273103.1 | Fwd | 5'-CCTGTGCCATTGAGACCTTT-3' | 208 |
| | | Rev | 5'-GTGCATGTGCTGAATTGCTT-3' | |
| <i>AcWRKY70</i> | * | Fwd | 5'-TGGAGAGTTCGCTGGTCAA-3' | 210 |
| | | Rev | 5'-TACAGCCTCTGCGAGAAACG-3' | |
| <i>AcACT</i> | GU570135.2 | Fwd | 5'-GCACCAAGAGCAGTATTC-3' | 183 |
| | | Rev | 5'-CCAAATCTTCTCCATGTCA-3' | |

* Primers for amplification of *AcWRKY70* gene were designed based on the onion transcriptome dataset made available by Ghodke et al. [156].