



# Comparative transcriptomic analyses of four phalaenopsis species to identify and characterize the *WUSCHEL*-related homeobox (*WOX*) gene family

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## Abstract

In the present study, we identified and characterized the plant-specific *WUSCHEL*-related homeobox (*WOX*) gene family that plays a major role in the determination of cell fate, early embryonic pattern formation, stem cell maintenance, organogenesis, flower development and somatic embryogenesis. For this purpose, the transcriptomes of four species of *Phalaenopsis*, namely *P. aphrodite*, *P. modesta*, *P. bellina* and *P. lueddemanniana*, were analysed, and nine *PaWOX*, ten *PmWOX*, eight *PbWOX* and nine *PIWOX* transcripts were identified. The duplication event analysis showed the presence of two duplication events in *P. lueddemanniana*, one each in *P. bellina* and *P. modesta* and no duplication event in *P. aphrodite*. During the evolutionary analysis, all the *WOX* proteins were clustered with those of *Arabidopsis thaliana* (AtWOX), *Phalaenopsis equestris* (PeWOX), *Apostasia shenzhenica* and *Dendrobium catenatum* (DcWOX). The expression analysis of the *WOX* genes suggested their critical role in floral development and in other developmental processes. The secondary and tertiary structural analysis of seven selected *WOX* proteins was then performed, with each protein representing its respective clade. The results provide a valuable resource for further studies of the molecular mechanisms of floral and vegetative developments in *Phalaenopsis* species.

**Key words:** *WUSCHEL*, *WOX*, expression analysis, *Phalaenopsis*, orchids

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Table S1. Ortholog Prediction of WOX proteins

| <i>P. modesta</i> and <i>P. equestris</i> |          |                 |          | <i>P. modesta</i> and <i>D. catenatum</i> |         |                 |          | <i>P. modesta</i> and <i>A. thaliana</i> |         |                 |          | <i>P. modesta</i> and <i>A. shenzhenica</i> |         |                 |          |
|-------------------------------------------|----------|-----------------|----------|-------------------------------------------|---------|-----------------|----------|------------------------------------------|---------|-----------------|----------|---------------------------------------------|---------|-----------------|----------|
| PmWOX                                     | PeWOX    | <i>E</i> value  | identity | PmWOX                                     | DcWOX   | <i>E</i> value  | identity | PmWOX                                    | AtWOX   | <i>E</i> value  | identity | PmWOX                                       | AsWOX   | <i>E</i> -value | identity |
| PmWOX11                                   | PeWOX11  | 0               | 95.75%   | PmWOX11                                   | DcWOX11 | 9.00E-116       | 78.24%   | PmWOX11                                  | AtWOX11 | 3.00E-58        | 45.30%   | PmWOX11                                     | AsWOX11 | 1.00E-27        | 72.22%   |
| PmWOX13                                   | PeWOX13A | 0               | 98.00%   | PmWOX13                                   | DcWOX13 | 8.00E-143       | 82.76%   | PmWOX13                                  | AtWOX13 | 5.00E-75        | 52.34%   | PmWOX13                                     | AsWOX13 | 6.00E-86        | 57.66%   |
| PmWOX7                                    | PeWOX7   | 2.00E-62        | 95.45%   | PmWOX7                                    | DcWOX7  | 8.00E-54        | 82.76%   | PmWOX7                                   | AtWOX7  | 6.00E-26        | 82.61%   | PmWOX7                                      | AsWOX7  | 7.00E-30        | 80.00%   |
| PmWOX4b                                   | PeWOX4   | 3.00E-56        | 72.97%   | PmWOX4b                                   | DcWOX4  | 1.00E-45        | 67.24%   | PmWOX4b                                  | AtWOX4  | 7.00E-27        | 74.14%   | PmWOX4b                                     | AsWOX3B | 3.00E-22        | 75.00%   |
| PmWOX4a                                   | PeWOX4   | 1.00E-114       | 80.66%   | PmWOX4a                                   | DcWOX4  | 3.00E-74        | 66.82%   | PmWOX4a                                  | AtWOX4  | 2.00E-39        | 50.31%   | PmWOX4a                                     | AsWOX2A | 3.00E-30        | 63.77%   |
| PmWOX9                                    | PeWOX9A  | 0.00E+00        | 97.12%   | PmWOX9                                    | DcWOX9  | 1.00E-171       | 78.29%   | PmWOX9                                   | AtWOX9  | 6.00E-61        | 75.61%   | PmWOX9                                      | AsWOX9  | 4.00E-109       | 54.15%   |
| PmWOX3b                                   | PeWOX3B  | 3.00E-38        | 91.38%   | PmWOX3b                                   | DcWOX3B | 5.00E-40        | 84.29%   | PmWOX3b                                  | AtWOX3  | 2.00E-36        | 84.48%   | PmWOX3b                                     | AsWOX3B | 5.00E-42        | 62.39%   |
| PmWUS                                     | PeWUS    | 2.00E-93        | 99.20%   | PmWUS                                     | DcWOX2  | 5.00E-29        | 65.15%   | PmWUS                                    | AtWUS   | 1.00E-39        | 72.22%   | PmWUS                                       | AsWUS   | 1.00E-53        | 77.78%   |
| PmWOX2                                    | PeWOX2   | 1.00E-140       | 94.71%   | PmWOX2                                    | DcWOX2  | 9.00E-118       | 77.62%   | PmWOX2                                   | AtWOX2  | 1.00E-46        | 40.50%   | PmWOX2                                      | AsWOX2A | 1.00E-63        | 48.33%   |
| PmWOX10                                   | PeWOX10  | 4.00E-171       | 95.65%   | PmWOX10                                   | DcWOX10 | 2.00E-110       | 77.16%   | PmWOX10                                  | AtWOX14 | 9.00E-45        | 44.22%   | PmWOX10                                     | AsWOX13 | 2.00E-84        | 58.02%   |
| PmWOX4c                                   | PeWOX4   | 2.00E-59        | 95.24%   | PmWOX4c                                   | DcWOX4  | 3.00E-49        | 89.47%   | PmWOX4c                                  | AtWOX4  | 5.00E-39        | 69.41%   | PmWOX4c                                     | AsWOX3B | 5.00E-31        | 68.75%   |
| <i>P. bellina</i> and <i>P. equestris</i> |          |                 |          | <i>P. bellina</i> and <i>D. catenatum</i> |         |                 |          | <i>P. bellina</i> and <i>A. thaliana</i> |         |                 |          | <i>P. bellina</i> and <i>A. shenzhenica</i> |         |                 |          |
| PbWOX                                     | PeWOX    | <i>E</i> -value | Identity | PbWOX                                     | DcWOX   | <i>E</i> -value | Identity | PbWOX                                    | AtWOX   | <i>E</i> -value | Identity | PbWOX                                       | AsWOX   | <i>E</i> -value | Identity |
| PbWOX12                                   | PeWOX12  | 3.00E-178       | 95.95%   | PbWOX12                                   | DcWOX12 | 2.00E-117       | 76.61%   | PbWOX12                                  | AtWOX12 | 3.00E-57        | 44.06%   | PbWOX12                                     | AsWOX9  | 4.00E-33        | 70.15%   |
| PbWOX9                                    | PeWOX9A  | 1.00E-178       | 87.46%   | PbWOX9                                    | DcWOX9  | 3.00E-139       | 70.35%   | PbWOX9                                   | AtWOX8  | 4.00E-62        | 40.35%   | PbWOX9                                      | AsWOX9  | 4.00E-89        | 52.65%   |
| PbWOX10                                   | PeWOX10  | 1.00E-171       | 95.22%   | PbWOX10                                   | DcWOX10 | 4.00E-113       | 78.68%   | PbWOX10                                  | AtWOX13 | 4.00E-52        | 59.06%   | PbWOX10                                     | AsWOX13 | 5.00E-85        | 58.49%   |
| PbWOX13a                                  | PeWOX13a | 0.00E+00        | 98.75%   | PbWOX13a                                  | DcWOX13 | 1.00E-134       | 82.07%   | PbWOX13b                                 | AtWOX13 | 1.00E-74        | 54.02%   | PbWOX13b                                    | AsWOX13 | 5.00E-86        | 57.73%   |
| PbWOX13b                                  | PeWOX13a | 0.00E+00        | 97.60%   | PbWOX13b                                  | DcWOX13 | 1.00E-141       | 82.38%   | PbWOX13a                                 | AtWOX13 | 7.00E-75        | 52.34%   | PbWOX13a                                    | AsWOX13 | 6.00E-85        | 57.21%   |
| PbWOX7                                    | PeWOX7   | 4.00E-136       | 95.08%   | PbWOX7                                    | DcWOX7  | 4.00E-114       | 80.98%   | PbWOX7                                   | AtWOX5  | 3.00E-39        | 42.86%   | PbWOX7                                      | AsWOX7  | 8.00E-41        | 80.26%   |
| PbWOX4                                    | PeWOX4   | 4.00E-100       | 78.95%   | PbWOX4                                    | DcWOX4  | 2.00E-74        | 61.79%   | PbWOX4                                   | AtWOX4  | 7.00E-38        | 44.85%   | PbWOX4                                      | AsWOX3B | 9.00E-31        | 68.75%   |
| PbWOX2                                    | PeWOX2   | 7.00E-141       | 95.15%   | PbWOX2                                    | DcWOX2  | 1.00E-117       | 78.10%   | PbWOX2                                   | AtWOX2  | 4.00E-46        | 40.08%   | PbWOX2                                      | AsWOX2A | 1.00E-63        | 50.42%   |

cont. Table S1

| <i>P. lueddemanniana</i> and <i>P. equestris</i> |          |           |          | <i>P. lueddemanniana</i> and <i>D. catenatum</i> |          |           |          | <i>P. lueddemanniana</i> and <i>A. thaliana</i> |         |          |          | <i>P. lueddemanniana</i> and <i>A. shenzhenica</i> |         |           |          |
|--------------------------------------------------|----------|-----------|----------|--------------------------------------------------|----------|-----------|----------|-------------------------------------------------|---------|----------|----------|----------------------------------------------------|---------|-----------|----------|
| PIWOX                                            | PeWOX    | E-value   | Identity | PIWOX                                            | DcWOX    | E-value   | Identity | PIWOX                                           | AtWOX   | E-value  | Identity | PIWOX                                              | AsWOX   | E-value   | Identity |
| PIWOX11                                          | PeWOX11  | 2.00E-74  | 91.71%   | PIWOX11                                          | DcWOX11  | 2.00E-63  | 82.26%   | PIWOX11                                         | AtWOX11 | 3.00E-37 | 83.33%   | PIWOX11                                            | AsWOX11 | 2.00E-28  | 72.22%   |
| PIWOX10                                          | PeWOX10  | 8.00E-171 | 95.22%   | PIWOX10                                          | DcWOX10  | 2.00E-111 | 77.66%   | PIWOX10                                         | AtWOX13 | 3.00E-52 | 59.06%   | PIWOX10                                            | AsWOX13 | 2.00E-84  | 58.02%   |
| PIWOX13                                          | PeWOXA   | 0         | 97.57%   | PIWOX13                                          | DcWOX13  | 2.00E-139 | 82.56%   | PIWOX13                                         | AtWOX13 | 2.00E-76 | 52.10%   | PIWOX13                                            | AsWOX13 | 2.00E-86  | 57.73%   |
| PIWOX7                                           | PeWOX7   | 8.00E-137 | 95.08%   | PIWOX7                                           | DcWOX7   | 4.00E-115 | 80.98%   | PIWOX7                                          | AtWOX5  | 3.00E-38 | 41.80%   | PIWOX7                                             | AsWOX7  | 1.00E-40  | 78.95%   |
| PIWOX4a                                          | PeWOX4   | 3.00E-102 | 81.34%   | PIWOX4a                                          | DcWOX4   | 2.00E-76  | 62.74%   | PIWOX4a                                         | AtWOX4  | 2.00E-38 | 45.45%   | PIWOX4a                                            | AsWOX3B | 9.00E-31  | 68.75%   |
| PIWOX4b                                          | PeWOX4   | 4.00E-122 | 85.38%   | PIWOX4b                                          | DcWOX4   | 1.00E-81  | 70.51%   | PIWOX4b                                         | AtWOX4  | 5.00E-40 | 39.84%   | PIWOX4b                                            | AsWOX3B | 3.00E-30  | 68.75%   |
| PIWOX12                                          | PeWOX12  | 1.00E-61  | 96.00%   | PIWOX12                                          | DcWOX12  | 4.00E-56  | 84.48%   | PIWOX12                                         | AtWOX11 | 2.00E-39 | 69.32%   | PIWOX12                                            | AsWOX9  | 7.00E-34  | 70.15%   |
| PIWOX4c                                          | PeWOX4   | 4.00E-86  | 94.89%   | PIWOX4c                                          | DcWOX4   | 9.00E-71  | 76.26%   | PIWOX4c                                         | AtWOX4  | 8.00E-39 | 45.45%   | PIWOX4c                                            | AsWOX3B | 4.00E-31  | 68.75%   |
| PIWOX9                                           | PeWOX9A  | 0         | 96.47%   | PIWOX9                                           | DcWOX9   | 2.00E-172 | 78.29%   | PIWOX9                                          | AtWOX9  | 4.00E-61 | 75.61%   | PIWOX9                                             | AsWOX9  | 4.00E-110 | 53.87%   |
| <i>P. aphrodite</i> and <i>P. equestris</i>      |          |           |          | <i>P. aphrodite</i> and <i>D. catenatum</i>      |          |           |          | <i>P. aphrodite</i> and <i>A. thaliana</i>      |         |          |          | <i>P. aphrodite</i> and <i>A. shenzhenica</i>      |         |           |          |
| PaWOX                                            | PeWOX    | E-value   | Identity | PaWOX                                            | DcWOX    | E-value   | Identity | PaWOX                                           | AtWOX   | E-value  | Identity | PaWOX                                              | AsWOX   | E-value   | Identity |
| PaWOX10                                          | PeWOX10  | 6.00E-174 | 96.52%   | PaWOX10                                          | DcWOX10  | 1.00E-109 | 76.14%   | PaWOX10                                         | AtWOX13 | 1.00E-50 | 58.27%   | PaWOX10                                            | AsWOX10 | 5.00E-82  | 56.60%   |
| PaWOX13                                          | PeWOX13A | 0         | 98.80%   | PaWOX13                                          | DcWOX13  | 1.00E-141 | 81.54%   | PaWOX13                                         | AtWOX13 | 3.00E-74 | 52.14%   | PaWOX13                                            | AsWOX13 | 6.00E-86  | 57.99%   |
| PaWOX12                                          | PeWOX12  | 6.00E-179 | 96.36%   | PaWOX12                                          | DcWOX12  | 2.00E-117 | 78.23%   | PaWOX12                                         | AtWOX12 | 1.00E-56 | 44.49%   | PaWOX12                                            | AsWOX9  | 4.00E-33  | 70.15%   |
| PaWOX3B                                          | PeWOX3B  | 1.00E-146 | 86.02%   | PaWOX3B                                          | DcWOX13B | 3.00E-103 | 70.43%   | PaWOX3B                                         | AtWOX3  | 3.00E-44 | 82.43%   | PaWOX3B                                            | AsWOX3B | 2.00E-68  | 54.04%   |
| PaWOX4                                           | PeWOX4   | 2.00E-115 | 88.57%   | PaWOX4                                           | DcWOX4   | 2.00E-80  | 65.30%   | PaWOX4                                          | AtWOX4  | 3.00E-39 | 38.58%   | PaWOX4                                             | AsWOX3B | 2.00E-30  | 68.75%   |
| PaWOX3A                                          | PeWOX3B  | 6.00E-64  | 61.42%   | PaWOX3A                                          | DcWOX3B  | 6.00E-73  | 60.00%   | PaWOX3A                                         | AtWOX3  | 3.00E-44 | 82.43%   | PaWOX3A                                            | AsWOX3B | 3.00E-74  | 62.00%   |
| PaWUS                                            | PeWUS    | 2.00E-176 | 99.13%   | PaWUS                                            | DcWOX2   | 3.00E-27  | 66.67%   | PaWUS                                           | AtWUS   | 2.00E-38 | 72.22%   | PaWUS                                              | AsWUS   | 4.00E-70  | 51.65%   |
| PaWOX9                                           | PeWOX9A  | 0         | 98.08%   | PaWOX9                                           | DcWOX9   | 1.00E-170 | 78.59%   | PaWOX9                                          | AtWO9   | 3.00E-61 | 75.61%   | PaWOX9                                             | AsWOX9  | 1.00E-111 | 53.30%   |
| PaWOX11                                          | PeWOX11  | 8.00E-107 | 76.83%   | PaWOX11                                          | DcWOX11  | 4.00E-84  | 60.31%   | PaWOX11                                         | AtWOX11 | 2.00E-32 | 31.02%   | PaWOX11                                            | AsWOX12 | 2.00E-22  | 63.79%   |
| PaWOX7                                           | PeWOX7   | 7.00E-126 | 95.38%   | PaWOX7                                           | DcWOX7   | 2.00E-102 | 81.03%   | PaWOX7                                          | AtWOX7  | 7.00E-35 | 68.75%   | PaWOX7                                             | AsWOX7  | 8.00E-38  | 80.26%   |

Table S2. Similarity index of *P. aphrodite*, *P. modesta*, *P. bellina* and *P. lueddemanniana*

| Similarity index of <i>P. modesta</i> |                |               |                |                |                 |                 |               |                |                |                |
|---------------------------------------|----------------|---------------|----------------|----------------|-----------------|-----------------|---------------|----------------|----------------|----------------|
| Gene                                  | <i>PmWOX11</i> | <i>PmWOX9</i> | <i>PmWOX10</i> | <i>PmWOX13</i> | <i>PmWOX2</i>   | <i>PmWUS</i>    | <i>PmWOX7</i> | <i>PmWOX3b</i> | <i>PmWOX4a</i> | <i>PmWOX4b</i> |
| <i>PmWOX11</i>                        | 100.00         | 46.00         | 43.67          | 44.09          | 43.09           | 44.85           | 47.01         | 45.52          | 45.08          | 48.16          |
| <i>PmWOX9</i>                         | 46.00          | 100.00        | 43.97          | 42.88          | 43.74           | 45.35           | 48.65         | 44.48          | 45.42          | 45.92          |
| <i>PmWOX10</i>                        | 43.67          | 43.97         | 100.00         | 56.84          | 44.04           | 46.42           | 43.83         | 46.22          | 49.64          | 51.84          |
| <i>PmWOX13</i>                        | 44.09          | 42.88         | 56.84          | 100.00         | 45.54           | 45.73           | 45.12         | 45.88          | 55.36          | 54.38          |
| <i>PmWOX2</i>                         | 43.09          | 43.74         | 44.04          | 45.54          | 100.00          | 51.81           | 53.05         | 53.44          | 55.96          | 60.89          |
| <i>PmWUS</i>                          | 44.85          | 45.35         | 46.42          | 45.73          | 51.81           | 100.00          | 50.61         | 52.70          | 54.79          | 57.26          |
| <i>PmWOX7</i>                         | 47.01          | 48.65         | 43.83          | 45.12          | 53.05           | 50.61           | 100.00        | 55.56          | 55.89          | 56.19          |
| <i>PmWOX3b</i>                        | 45.52          | 44.48         | 46.22          | 45.88          | 53.44           | 52.7            | 55.56         | 100.00         | 64.38          | 64.38          |
| <i>PmWOX4a</i>                        | 45.08          | 45.42         | 49.64          | 55.36          | 55.96           | 54.79           | 55.89         | 64.38          | 100.00         | 86.19          |
| <i>PmWOX4b</i>                        | 48.16          | 45.92         | 51.84          | 54.38          | 60.89           | 57.26           | 56.19         | 64.38          | 86.19          | 100.00         |
| Similarity index of <i>P. bellina</i> |                |               |                |                |                 |                 |               |                |                |                |
| Gene                                  | <i>PbWOX12</i> | <i>PbWOX7</i> | <i>PbWOX9</i>  | <i>PbWOX10</i> | <i>PbWOX13a</i> | <i>PbWOX13b</i> | <i>PbWOX2</i> | <i>PbWOX4</i>  |                |                |
| <i>PbWOX12</i>                        | 100.00         | 44.44         | 51.49          | 47.77          | 49.70           | 49.44           | 44.17         | 45.90          |                |                |
| <i>PbWOX7</i>                         | 44.44          | 100.00        | 44.55          | 44.91          | 47.71           | 47.75           | 51.42         | 50.74          |                |                |
| <i>PbWOX9</i>                         | 51.49          | 44.55         | 100.00         | 45.19          | 44.68           | 45.01           | 41.93         | 49.02          |                |                |
| <i>PbWOX10</i>                        | 47.77          | 44.91         | 45.19          | 100.00         | 58.39           | 58.05           | 46.65         | 49.01          |                |                |
| <i>PbWOX13a</i>                       | 49.70          | 47.71         | 44.68          | 58.39          | 100.00          | 98.06           | 46.51         | 51.79          |                |                |
| <i>PbWOX13b</i>                       | 49.44          | 47.75         | 45.01          | 58.05          | 98.06           | 100.00          | 44.55         | 50.59          |                |                |
| <i>PbWOX2</i>                         | 44.17          | 51.42         | 41.93          | 46.65          | 46.51           | 44.55           | 100.00        | 54.38          |                |                |
| <i>PbWOX4</i>                         | 45.90          | 50.74         | 49.02          | 49.01          | 51.79           | 50.59           | 54.38         | 100.00         |                |                |

cont. Table S2

| Similarity index of <i>P. lueddemanniana</i> |                |                |                |                |                |                |               |                |                |
|----------------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|---------------|----------------|----------------|
| Gene name                                    | <i>PIWOX7</i>  | <i>PIWOX10</i> | <i>PIWOX13</i> | <i>PIWOX4c</i> | <i>PIWOX4a</i> | <i>PIWOX4b</i> | <i>PIWOX9</i> | <i>PIWOX11</i> | <i>PIWOX12</i> |
| <i>PIWOX7</i>                                | 100.00         | 45.50          | 43.91          | 51.95          | 53.62          | 53.77          | 43.86         | 40.37          | 50.74          |
| <i>PIWOX10</i>                               | 45.50          | 100.00         | 60.69          | 51.03          | 49.21          | 47.84          | 45.33         | 43.24          | 50.00          |
| <i>PIWOX13</i>                               | 43.91          | 60.69          | 100.00         | 59.86          | 55.78          | 52.23          | 45.37         | 47.05          | 49.12          |
| <i>PIWOX4c</i>                               | 51.95          | 51.03          | 59.86          | 100.00         | 96.64          | 96.84          | 48.67         | 45.48          | 51.24          |
| <i>PIWOX4a</i>                               | 53.62          | 49.21          | 55.78          | 96.64          | 100.00         | 99.63          | 50.63         | 46.48          | 52.06          |
| <i>PIWOX4b</i>                               | 53.77          | 47.84          | 52.23          | 96.84          | 99.63          | 100.00         | 49.61         | 46.34          | 51.49          |
| <i>PIWOX9</i>                                | 43.86          | 45.33          | 45.37          | 48.67          | 50.63          | 49.61          | 100.00        | 47.97          | 58.50          |
| <i>PIWOX11</i>                               | 40.37          | 43.24          | 47.05          | 45.48          | 46.48          | 46.34          | 47.97         | 100.00         | 66.67          |
| <i>PIWOX12</i>                               | 50.74          | 50.00          | 49.12          | 51.24          | 52.06          | 51.49          | 58.50         | 66.67          | 100.00         |
| Similarity index of <i>P. aphrodite</i>      |                |                |                |                |                |                |               |                |                |
| Gene name                                    | <i>PaWOX10</i> | <i>PaWOX7</i>  | <i>PaWOX13</i> | <i>PaWUS</i>   | <i>PaWOX12</i> | <i>PaWOX9</i>  | <i>PaWOX4</i> | <i>PaWOX3b</i> | <i>PaWOX3a</i> |
| <i>PaWOX10</i>                               | 100.00         | 43.30          | 58.82          | 44.94          | 45.60          | 44.01          | 46.53         | 46.12          | 47.07          |
| <i>PaWOX7</i>                                | 43.30          | 100.00         | 43.47          | 44.35          | 42.20          | 37.38          | 47.83         | 45.28          | 47.55          |
| <i>PaWOX13</i>                               | 58.82          | 43.47          | 100.00         | 44.93          | 47.71          | 42.27          | 47.29         | 47.33          | 47.91          |
| <i>PaWUS</i>                                 | 44.94          | 44.35          | 44.93          | 100.00         | 45.78          | 40.33          | 51.65         | 50.00          | 50.10          |
| <i>PaWOX12</i>                               | 45.60          | 42.20          | 47.71          | 45.78          | 100.00         | 47.95          | 48.34         | 47.34          | 48.92          |
| <i>PaWOX9</i>                                | 44.01          | 37.38          | 42.27          | 40.33          | 47.95          | 100.00         | 46.22         | 43.94          | 44.97          |
| <i>PaWOX4</i>                                | 46.53          | 47.83          | 47.29          | 51.65          | 48.34          | 46.22          | 100.00        | 60.10          | 60.36          |
| <i>PaWOX3b</i>                               | 46.12          | 45.28          | 47.33          | 50.00          | 47.34          | 43.94          | 60.10         | 100.00         | 67.42          |
| <i>PaWOX3a</i>                               | 47.07          | 47.55          | 47.91          | 50.10          | 48.92          | 44.97          | 60.36         | 67.42          | 100.00         |

Table S3. RPKM values for WOX genes in different tissues in *P. bellina*, *P. modesta*, *P. aphrodite* and *P. lueddemanniana*

| <i>Phalaenopsis bellina</i>        |             |             |                       |                         |                         |
|------------------------------------|-------------|-------------|-----------------------|-------------------------|-------------------------|
| Gene                               | Root (R)    | Leaf (L)    | Large floral bud (LB) | Fully opened flower (F) |                         |
| <i>PbWOX2</i>                      | 0           | 0           | 0.321265821           | 0                       |                         |
| <i>PbWOX4</i>                      | 2.922448125 | 0.71456711  | 1.56491362            | 0.138711175             |                         |
| <i>PbWOX7</i>                      | 2.432522666 | 0           | 0.133860759           | 0                       |                         |
| <i>PbWOX9</i>                      | 0           | 0           | 4.971971035           | 0.662755103             |                         |
| <i>PbWOX12</i>                     | 2.017659672 | 0           | 0                     | 0                       |                         |
| <i>PbWOX10</i>                     | 5.651315285 | 0.119756155 | 1.026265816           | 0                       |                         |
| <i>PbWOX13a</i>                    | 483.3569963 | 35.50769985 | 116.63511             | 24.63597166             |                         |
| <i>PbWOX13b</i>                    | 476.8179067 | 35.7264576  | 118.1473188           | 24.80664236             |                         |
| <i>Phalaenopsis leuddemanniana</i> |             |             |                       |                         |                         |
| Gene                               | Root (R)    | Leaf (L)    | Large bud (LB)        | Small bud (SB)          | Fully opened flower (F) |
| <i>PIWOX4a</i>                     | 4.094416234 | 7.457805216 | 5.497833137           | 5.252682325             | 2.209524058             |
| <i>PIWOX4b</i>                     | 3.512271746 | 6.859920301 | 4.7161507             | 4.505855454             | 1.952809285             |
| <i>PIWOX4c</i>                     | 2.66613773  | 3.544588608 | 3.773431519           | 3.68206858              | 1.398335156             |
| <i>PIWOX7</i>                      | 11.34320416 | 0           | 0.304687017           | 1.363524646             | 0                       |
| <i>PIWOX9</i>                      | 5.566422583 | 3.132039779 | 0.119962363           | 0                       | 0.103728143             |
| <i>PIWOX11</i>                     | 10.92748464 | 2.128718136 | 0                     | 0.138268688             | 0.126899525             |
| <i>PIWOX12</i>                     | 0.515600189 | 0           | 0                     | 0                       | 0                       |
| <i>PIWOX10</i>                     | 13.04468478 | 0.135528388 | 0.583983449           | 2.750970778             | 0                       |
| <i>PIWOX13</i>                     | 159.593189  | 34.47339845 | 72.40492868           | 40.83757702             | 25.82870805             |

cont. Table S3

| <i>Phalaenopsis modesta</i>   |                |                |                         |                       |                       |
|-------------------------------|----------------|----------------|-------------------------|-----------------------|-----------------------|
| Gene                          | Small bud (SB) | Large bud (LB) | Fully opened flower (F) |                       |                       |
| <i>PmWUS</i>                  | 1.288137713    | 0.080423207    | 0                       |                       |                       |
| <i>PmWOX2</i>                 | 1.382417529    | 1.483243802    | 0.668683521             |                       |                       |
| <i>PmWOX3b</i>                | 0.747784571    | 0              | 0                       |                       |                       |
| <i>PmWOX4a</i>                | 5.22799147     | 0.755052414    | 0.885903901             |                       |                       |
| <i>PmWOX4b</i>                | 5.227051353    | 0.812234382    | 0.933546684             |                       |                       |
| <i>PmWOX7</i>                 | 0.642591634    | 0              | 0                       |                       |                       |
| <i>PmWOX9</i>                 | 23.16041675    | 12.70789782    | 8.382284257             |                       |                       |
| <i>PmWOX11</i>                | 0              | 1.30571269     | 0                       |                       |                       |
| <i>PmWOX10</i>                | 1.65378097     | 1.214725527    | 0.097730668             |                       |                       |
| <i>PmWOX13</i>                | 120.5977236    | 260.3132607    | 196.4269627             |                       |                       |
| <i>Phalaenopsis aphrodite</i> |                |                |                         |                       |                       |
| Gene                          | Root (R)       | Leaf (L)       | Fully opened flower (F) | Large floral bud (LB) | Small floral bud (SB) |
| <i>PaWUS</i>                  | 0              | 0              | 0.461614001             | 2.998459095           | 0.337609409           |
| <i>PaWOX3A</i>                | 0              | 0              | 0                       | 0                     | 0                     |
| <i>PaWOX3B</i>                | 0              | 0              | 0                       | 0                     | 0                     |
| <i>PaWOX4</i>                 | 0.918688991    | 0.443342255    | 4.676878693             | 5.608453854           | 7.929378885           |
| <i>PaWOX7</i>                 | 0.265358735    | 0              | 0.210528794             | 0.210386226           | 0.635142282           |
| <i>PaWOX9</i>                 | 0.275030975    | 0              | 3.818543749             | 2.146476296           | 10.83939287           |
| <i>PaWOX12</i>                | 0.796912059    | 0              | 0                       | 0                     | 0                     |
| <i>PaWOX10</i>                | 8.480264964    | 0.193038607    | 0.814556372             | 1.85001082            | 4.38681226            |
| <i>PaWOX13</i>                | 85.19946204    | 59.30146007    | 712.378421              | 876.0704037           | 160.7328012           |