**Additional file 3**  Correlation coefficients among the position of genes along the first two major axes with various indexes of PA polymerase genes’ codon usage.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variables** | **A(%)** | **C(%)** | **G(%)** | **U(%)** | **U3 (%)** | **C3(%)** | **A3(%)** | **G3(%)** | **%GC** | **%GC1** | **%GC2** | **%GC3** | **GC12** | **GC3s** | **ENc** | **CAI** | **Axis1** |
| **A(%)** |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| **C(%)** | -0.913\*\* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **G(%)** | -0.889\*\* | 0.747\*\* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **U(%)** | 0.604\*\* | -0.755\*\* | -0.681\*\* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **U3 (%)** | 0.560\*\* | -0.651\*\* | -0.688\*\* | 0.923\*\* |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **C3(%)** | -0.880\*\* | 0.948\*\* | 0.755\*\* | -0.774\*\* | -0.737\*\* |  |  |  |  |  |  |  |  |  |  |  |  |
| **A3(%)** | 0.961\*\* | -0.878\*\* | -0.850\*\* | 0.573\*\* | 0.552\*\* | -0.850\*\* |  |  |  |  |  |  |  |  |  |  |  |
| **G3(%)** | -0.782\*\* | 0.672\*\* | 0.899\*\* | -0.635\*\* | -0.706\*\* | 0.674\*\* | -0.843\*\* |  |  |  |  |  |  |  |  |  |  |
| **%GC** | -0.968\*\* | 0.947\*\* | 0.896\*\* | -0.728\*\* | -0.667\*\* | 0.926\*\* | -0.920\*\* | 0.784\*\* |  |  |  |  |  |  |  |  |  |
| **%GC1** | -0.498\*\* | 0.469\*\* | 0.410\*\* | -0.263\* | -0.099\* | 0.400\*\* | -0.343\* | 0.100 | 0.508\*\* |  |  |  |  |  |  |  |  |
| **%GC2** | -0.642\*\* | 0.676\*\* | 0.553\*\* | -0.543\*\* | -0.426\*\* | 0.570\*\* | -0.592\*\* | 0.498\*\* | 0.635\*\* | 0.066 |  |  |  |  |  |  |  |
| **%GC3** | -0.881\*\* | 0.870\*\* | 0.869\*\* | -0.751\*\* | -0.784\*\* | 0.908\*\* | -0.908\*\* | 0.886\*\* | 0.922\*\* | 0.280\* | 0.518\*\* |  |  |  |  |  |  |
| **GC12** | -0.830\*\* | 0.828\*\* | 0.709\*\* | -0.595\*\* | -0.427\*\* | 0.723\*\* | -0.699\*\* | 0.472\*\* | 0.832\*\* | 0.737\*\* | 0.678\*\* | 0.613\*\* |  |  |  |  |  |
| **GC3s** | -0.875\*\* | 0.879\*\* | 0.851\*\* | -0.753\*\* | -0.774\*\* | 0.905\*\* | -0.909\*\* | 0.880\*\* | 0.917\*\* | 0.257\* | 0.546\*\* | 0.995\*\* | 0.611\*\* |  |  |  |  |
| **ENc** | -0.611\*\* | 0.536\*\* | 0.541\*\* | -0.332\* | -0.389\*\* | 0.542\*\* | -0.684\*\* | 0.645\*\* | 0.573\*\* | 0.003 | 0.312\* | 0.631\*\* | 0.286\* | 0.630\*\* |  |  |  |
| **CAI** | -0.779\*\* | 0.767\*\* | 0.798\*\* | -0.718\*\* | -0.693\*\* | 0.762\*\* | -0.771\*\* | 0.780\*\* | 0.809\*\* | 0.215\* | 0.610\*\* | 0.820\*\* | 0.606\*\* | 0.826\*\* | 0.361\*\* |  |  |
| **Axis1** | 0.911\*\* | -0.865\*\* | -0.774\*\* | 0.583\*\* | 0.564\*\* | -0.892\*\* | 0.910\*\* | -0.725\*\* | -0.880\*\* | -0.355\*\* | -0.575\*\* | -0.848\*\* | -0.703\*\* | -0.840\*\* | -0.659\*\* | -0.657\*\* |  |
| **Axis2** | 0.409\*\* | -0.353\*\* | -0.160 | -0.133 | -0.210\* | -0.327\* | 0.399\*\* | -0.067 | -0.329\* | -0.277\* | -0.278\* | -0.217\* | -0.344\* | -0.221\* | -0.022 | -0.132 | 0.469\*\* |

 \*\*p < 0.0001, \*p < 0.05

**Supplementary Table 2b. Correlation coefficients among the position of genes along the first two major axes with various indexes of PB1 polymerase genes’ codon usage.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variables** | **A(%)** | **C(%)** | **G(%)** | **U(%)** | **U3 (%)** | **C3(%)** | **A3(%)** | **G3(%)** | **%GC** | **%GC1** | **%GC2** | **%GC3** | **GC12** | **GC3s** | **ENc** | **CAI** | **Axis1** |
| **A(%)** |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| **C(%)** | -0.680\*\* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **G(%)** | -0.985\*\* | 0.657\*\* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **U(%)** | 0.648\*\* | -0.984\*\* | -0.639\*\* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **U3 (%)** | 0.707\*\* | -0.969\*\* | -0.698\*\* | 0.973\*\* |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **C3(%)** | -0.732\*\* | 0.976\*\* | 0.709\*\* | -0.950\*\* | -0.980\*\* |  |  |  |  |  |  |  |  |  |  |  |  |
| **A3(%)** | 0.981\*\* | -0.695\*\* | -0.961\*\* | 0.660\*\* | 0.714\*\* | -0.746\*\* |  |  |  |  |  |  |  |  |  |  |  |
| **G3(%)** | -0.978\*\* | 0.681\*\* | 0.974\*\* | -0.657\*\* | -0.709\*\* | 0.725\*\* | -0.992\*\* |  |  |  |  |  |  |  |  |  |  |
| **%GC** | -0.941\*\* | 0.807\*\* | 0.925\*\* | -0.788\*\* | -0.836\*\* | 0.852\*\* | -0.937\*\* | 0.929\*\* |  |  |  |  |  |  |  |  |  |
| **%GC1** | -0.651\*\* | 0.645\*\* | 0.663\*\* | -0.649\*\* | -0.632\*\* | 0.610\*\* | -0.608\*\* | 0.634\*\* | 0.692\*\* |  |  |  |  |  |  |  |  |
| **%GC2** | 0.783\*\* | -0.551\*\* | -0.757\*\* | 0.503\*\* | 0.564\*\* | -0.606\*\* | 0.852\*\* | -0.846\*\* | -0.747\*\* | -0.520\*\* |  |  |  |  |  |  |  |
| **%GC3** | -0.959\*\* | 0.752\*\* | 0.941\*\* | -0.730\*\* | -0.787\*\* | 0.809\*\* | -0.977\*\* | 0.969\*\* | 0.973\*\* | 0.610\*\* | -0.826\*\* |  |  |  |  |  |  |
| **GC12** | 0.255\* | 0.003 | -0.216\* | -0.057 | -0.001 | -0.066 | 0.370\*\* | -0.347\*\* | -0.169 | 0.279\* | 0.605\*\* | -0.332\* |  |  |  |  |  |
| **GC3s** | -0.958\*\* | 0.727\*\* | 0.937\*\* | -0.688\*\* | -0.735\*\* | 0.771\*\* | -0.971\*\* | 0.961\*\* | 0.939\*\* | 0.631\*\* | -0.830\*\* | 0.963\*\* | -0.315\* |  |  |  |  |
| **ENc** | -0.706\*\* | 0.281\* | 0.718\*\* | -0.278\* | -0.324\* | 0.324\* | -0.665\*\* | 0.677\*\* | 0.590\*\* | 0.386\*\* | -0.415\*\* | 0.614\*\* | -0.104 | 0.613\*\* |  |  |  |
| **CAI** | -0.788\*\* | 0.839\*\* | 0.782\*\* | -0.803\*\* | -0.862\*\* | 0.891\*\* | -0.794\*\* | 0.782\*\* | 0.844\*\* | 0.593\*\* | -0.706\*\* | 0.831\*\* | -0.176\* | 0.820\*\* | 0.301\* |  |  |
| **Axis1** | -0.944\*\* | 0.680\*\* | 0.930\*\* | -0.648\*\* | -0.694\*\* | 0.715\*\* | -0.956\*\* | 0.959\*\* | 0.889\*\* | 0.625\*\* | -0.838\*\* | 0.925\*\* | -0.316\* | 0.954\*\* | 0.668\*\* | 0.765\*\* |  |
| **Axis2** | 0.331\* | 0.192\* | -0.345\*\* | -0.169 | -0.173\* | 0.193\* | 0.326\* | -0.357\*\* | -0.160 | -0.060 | 0.233\* | -0.234\* | 0.229\* | -0.249\* | -0.678\*\* | 0.232\* | -0.353\*\* |

 \*\*p < 0.0001, \*p < 0.05

**Supplementary Table 2c. Correlation coefficients among the position of genes along the first two major axes with various indexes of PB2 polymerase genes’ codon usage.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variables** | **A(%)** | **C(%)** | **G(%)** | **U(%)** | **U3 (%)** | **C3(%)** | **A3(%)** | **G3(%)** | **%GC** | **%GC1** | **%GC2** | **%GC3** | **GC12** | **GC3s** | **ENc** | **CAI** | **Axis1** |
| **A(%)** |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| **C(%)** | -0.850\*\* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **G(%)** | -0.987\*\* | 0.837\*\* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **U(%)** | 0.668\*\* | -0.872\*\* | -0.710\*\* |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **U3 (%)** | 0.654\*\* | -0.851\*\* | -0.693\*\* | 0.949\*\* |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **C3(%)** | -0.851\*\* | 0.954\*\* | 0.856\*\* | -0.856\*\* | -0.892\*\* |  |  |  |  |  |  |  |  |  |  |  |  |
| **A3(%)** | 0.959\*\* | -0.854\*\* | -0.955\*\* | 0.684\*\* | 0.683\*\* | -0.881\*\* |  |  |  |  |  |  |  |  |  |  |  |
| **G3(%)** | -0.940\*\* | 0.873\*\* | 0.954\*\* | -0.753\*\* | -0.752\*\* | 0.893\*\* | -0.979\*\* |  |  |  |  |  |  |  |  |  |  |
| **%GC** | -0.978\*\* | 0.909\*\* | 0.983\*\* | -0.776\*\* | -0.762\*\* | 0.913\*\* | -0.953\*\* | 0.957\*\* |  |  |  |  |  |  |  |  |  |
| **%GC1** | -0.257\* | 0.129 | 0.281\* | -0.231\* | -0.188\* | 0.095 | -0.147 | 0.148 | 0.255\* |  |  |  |  |  |  |  |  |
| **%GC2** | -0.419\*\* | 0.285\* | 0.399\*\* | -0.198\* | -0.121 | 0.233\* | -0.299\* | 0.268\* | 0.377\*\* | 0.083 |  |  |  |  |  |  |  |
| **%GC3** | -0.937\*\* | 0.931\*\* | 0.939\*\* | -0.810\*\* | -0.810\*\* | 0.943\*\* | -0.954\*\* | 0.971\*\* | 0.971\*\* | 0.141 | 0.257\* |  |  |  |  |  |  |
| **GC12** | -0.492\*\* | 0.299\* | 0.490\*\* | -0.286\* | -0.221\* | 0.245\* | -0.343\* | 0.310\* | 0.461\*\* | 0.798\*\* | 0.588\*\* | 0.297\* |  |  |  |  |  |
| **GC3s** | -0.880\*\* | 0.917\*\* | 0.881\*\* | -0.814\*\* | -0.789\*\* | 0.902\*\* | -0.903\*\* | 0.933\*\* | 0.915\*\* | 0.079 | 0.249\* | 0.954\*\* | 0.239\* |  |  |  |  |
| **ENc** | -0.861\*\* | 0.851\*\* | 0.853\*\* | -0.688\*\* | -0.679\*\* | 0.849\*\* | -0.877\*\* | 0.887\*\* | 0.880\*\* | 0.035 | 0.175 | 0.906\*\* | 0.186\* | 0.895\*\* |  |  |  |
| **CAI** | -0.929\*\* | 0.861\*\* | 0.933\*\* | -0.748\*\* | -0.729\*\* | 0.865\*\* | -0.924\*\* | 0.943\*\* | 0.937\*\* | 0.140 | 0.337\* | 0.939\*\* | 0.338\* | 0.912\*\* | 0.823\*\* |  |  |
| **Axis1** | 0.844\*\* | -0.806\*\* | -0.854\*\* | 0.745\*\* | 0.727\*\* | -0.821\*\* | 0.852\*\* | -0.871\*\* | -0.859\*\* | -0.216\* | -0.221\* | -0.876\*\* | -0.329\* | -0.880\*\* | -0.840\*\* | -0.885\*\* |  |
| **Axis2** | -0.904\*\* | 0.891\*\* | 0.912\*\* | -0.788\*\* | -0.779\*\* | 0.900\*\* | -0.921\*\* | 0.946\*\* | 0.932\*\* | 0.131 | 0.270\* | 0.952\*\* | 0.301\* | 0.952\*\* | 0.851\*\* | 0.941\*\* | -0.882\*\* |

 \*\*p < 0.0001, \*p < 0.05