

Supplementary Materials: Phenotypic Diversity of *Litsea cubeba* in Jiangxi China and the Identification of Germplasms with Desirable Characteristics

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Table S1: Geographical locations and climatic conditions of 27 provenances in Jiangxi province

| NO. | Prove. | Abbr. | Longitude (°E) | Latitude (°N) | Elevation (m) | AAT (°C) | AAMaxT (°C) | AAMinT (°C) | AAR (mm) | AARH (%) | Samples for EO Extraction |
|-----|-----------|-------|-------------------|------------------|------------------|-------------|----------------|----------------|-------------|-------------|------------------------------|
| | | | 113°48' | 27°24' | 527 | | | | | | |
| 1 | Pingxiang | PX | 113°47' | 27°25' | 420 | 18.1 | 41.3 | -9.3 | 231.5 | 80 | 8 |
| | | | 113°57' | 27°40' | 165 | | | | | | |
| 2 | Lianhua | LH | 114°00' | 27°24' | 797 | 18.2 | 41.1 | -8.8 | 226.0 | 79 | 6 |
| | | | 114°01' | 27°26' | 770 | | | | | | |
| | | | 114°06' | 27°08' | 361 | | | | | | |
| 3 | Yongxin | YX | 114°07' | 27°09' | 262 | 18.3 | 42.0 | -7.2 | 208.2 | 81 | 10 |
| | | | 114°13' | 26°58' | 278 | | | | | | |
| 4 | Suichuan | SC | 114°18' | 26°25' | 662 | 19.1 | 41.2 | -6.0 | 222.3 | 78 | 0 |
| | | | 114°19' | 26°20' | 192 | | | | | | |
| 5 | Anfu | AF | 114°19' | 27°23' | 291 | 18.3 | 40.8 | -7.3 | 210.5 | 79 | 7 |
| | | | 114°31' | 27°26' | 256 | | | | | | |
| 6 | Jian | JA | 114°28' | 27°03' | 356 | 19.1 | 40.9 | -6.7 | 265.6 | 79 | 3 |
| | | | 114°28' | 27°03' | 168 | | | | | | |
| 7 | Taihe | TH | 115°09' | 26°41' | 138 | 19.2 | 41.5 | -6.0 | 230.6 | 77 | 6 |
| 8 | Wanan | WA | 114°55' | 26°30' | 449 | 18.8 | 41.0 | -6.9 | 247.0 | 80 | 5 |
| 9 | Xiushui | XS | 114°47' | 28°50' | 272 | 17.1 | 42.1 | -12.1 | 315.9 | 80 | 3 |
| 10 | Wuning | WN | 114°56' | 28°58' | 796 | 18.2 | 40.1 | -12.8 | 310.1 | 80 | 3 |
| 11 | Lushan | LS | 115°54' | 29°31' | 380 | 12.2 | 31.9 | -16.7 | 363.4 | 78 | 0 |
| 12 | Lean | LA | 115°51' | 27°12' | 155 | 18.0 | 40.7 | -11.1 | 253.0 | 78 | 0 |
| | | | 116°11' | 28°01' | 146 | | | | | | |
| 13 | Fuzhou | FZ | 116°11' | 28°01' | 153 | 17.9 | 41.0 | -12.2 | 253.3 | 82 | 0 |
| | | | 116°49' | 27°11' | 149 | | | | | | |
| 14 | Lichuan | LC | 117°00' | 27°08' | 303 | 18.5 | 42.2 | -12.3 | 346.0 | 81 | 12 |
| 15 | Shangyou | SY | 114°28' | 26°02' | 390 | 19.3 | 40.0 | -5.7 | 200.1 | 78 | 0 |
| 16 | Quannan | QN | 114°32' | 24°50' | 570 | 19.2 | 39.2 | -6.8 | 214.6 | 81 | 8 |
| 17 | Dayu | DY | 114°40' | 25°24' | 408 | 19.0 | 39.7 | -7.2 | 189.3 | 80 | 7 |
| 18 | Xinfeng | XF | 114°40' | 25°26' | 408 | 19.9 | 40.0 | -5.1 | 237.8 | 77 | 16 |
| 19 | Huichang | HC | 114°51' | 25°27' | 255 | 19.8 | 39.9 | -7.0 | 214.2 | 79 | 7 |
| 20 | Yudu | YD | 115°23' | 25°41' | 380 | 20.1 | 41.0 | -5.0 | 251.6 | 75 | 6 |
| 21 | Xingguo | XG | 115°05' | 26°26' | 450 | 19.3 | 40.4 | -6.3 | 276.1 | 77 | 0 |
| 22 | Ningdu | ND | 115°56' | 26°31' | 478 | 19.0 | 40.2 | -7.5 | 386.8 | 76 | 4 |
| 23 | Ruijin | RJ | 116°13' | 25°54' | 620 | 19.6 | 40.4 | -6.5 | 252.4 | 78 | 3 |
| 24 | Fuliang | FL | 117°20' | 29°36' | 112 | 18.0 | 40.3 | -9.4 | 350.1 | 80 | 6 |
| 25 | Guixi | GX | 117°23' | 27°56' | 275 | 18.9 | 41.1 | -9.3 | 319.3 | 76 | 10 |
| 26 | Leping | LP | 117°27' | 28°57' | 86 | 18.4 | 40.4 | -13.4 | 334.2 | 78 | 7 |
| 27 | Yushan | YS | 117°38' | 28°06' | 313 | 18.2 | 41.0 | -9.5 | 338.8 | 77 | 4 |

NO., number; Prove., provenances; Abbr., abbreviation; AAT, annual average temperature; AAMaxT, annual average maximum temperature; AAMinT, annual average minimum temperature; AARH, annual average relative humidity; AAR, annual average rainfall. The numbers of samples for EO extraction from 6 provenances are 0, because individual trees from these provenances were not able to successfully extract EO, and only 141 trees (from 21 provenances) have data on the EO content and components.

Table S2: Variation analysis on phenotypic traits of *L. cubeba* among provenances

| Traits | Mean±SE | Minmum value | Maxmum value | CV (%) | Shannon–Wiener index (<i>H'</i>) | phenotypic differentiation coefficient (<i>V_{st}</i>) |
|----------------------|-------------|--------------|--------------|--------|------------------------------------|--|
| TH (m) | 4.90±0.08 | 1.60 | 12.00 | 36.70 | 2.652 | 29.42% |
| GD (mm) | 5.39±1.49 | 2.50 | 35.00 | 63.29 | 2.030 | 29.29% |
| CW (m ²) | 7.32±6.00 | 0.55 | 60.00 | 82.02 | 1.968 | 11.95% |
| FFY (kg) | 1.06±0.09 | 0.07 | 19.50 | 190.84 | 0.002 | 10.48% |
| TSFW (g) | 129.51±1.06 | 67.91 | 229.84 | 18.81 | 2.787 | 20.20% |
| TSDW (g) | 47.93±0.45 | 34.96 | 70.04 | 21.42 | 2.810 | 10.31% |
| WC (%) | 62.73±0.25 | 45.96 | 77.97 | 9.21 | 2.872 | 17.38% |
| PR (%) | 79.36±0.18 | 67.16 | 90.45 | 5.06 | 2.847 | 16.66% |
| P:K | 4.06±0.05 | 2.05 | 9.50 | 26.85 | 2.578 | 14.63% |
| EO content (%) | 3.55±0.07 | 1.55 | 5.77 | 22.26 | 1.568 | 11.88% |
| CitrP (%) | 75.23±0.29 | 66.19 | 85.62 | 4.61 | 1.553 | 10.73% |
| NeralP (%) | 36.22±0.17 | 31.56 | 41.74 | 5.66 | 1.569 | 17.75% |
| GeranialP (%) | 39.01±0.17 | 34.38 | 45.49 | 5.26 | 1.549 | 7.49% |
| 4M3PP (%) | 0.97±0.10 | 0.00 | 4.98 | 124.19 | 1.270 | 19.49% |
| 1CCP4OP (%) | 1.74±0.19 | 0.00 | 9.50 | 126.91 | 1.270 | 23.43% |
| SabP (%) | 1.75±0.12 | 0.00 | 7.63 | 80.48 | 1.464 | 28.38% |
| D-LP (%) | 6.93±0.23 | 0.83 | 14.75 | 40.09 | 1.552 | 9.52% |
| LinalP (%) | 1.80±0.02 | 1.15 | 2.67 | 13.00 | 1.506 | 13.79% |
| CitroP (%) | 2.99±0.20 | 0.00 | 9.71 | 80.98 | 1.374 | 27.06% |
| 3,7-DP (%) | 4.96±0.29 | 0.00 | 10.94 | 68.43 | 1.270 | 38.13% |

TH, tree height; GD, ground diameter; CW, crown width; FFY, fresh fruit yield; TSDW, thousand seed dry weight; TSFW, thousand seed fresh weight; WC, water content; PR, pericarp ratio; P:K, pericarp:kernel; EO content, essential oil content; CitrP, citral proportion; NeralP, the proportion of neral; GeranialP, the proportion of geranial; 4M3PP, the proportion of 4-methyl-3-pentenal; 1CCP4OP, proportion of 1-(cyclopanecarbonyl)Piperidin-4-one; SabP, the proportion of Sabinene; D-LP, the proportion of D-limonene; LinaP, the proportion of linalool; CitroP, the proportion of citronellal; 3,7-DP, the proportion of 3,7-dimethyl-3,6-octadienal. SE, standard error; CV, coefficients of variation, $CV=\delta/\bar{X}\times100\%$. Shannon–Wiener index (*H'*) was calculated by the method as described by Hamil et al. (2021); Phenotypic differentiation coefficient (*V_{st}*) among provenances was caculated by Minitab (version 19.0).

Table S3 Nested variance analysis of phenotype traits in *L. cubeba*

| Traits | Mean square | | | <i>F</i> value | |
|----------------|-------------------|-------------------|---------------|-------------------|-------------------|
| | Within provenance | Among provenances | Random errors | Within provenance | Among provenances |
| TH (m) | 3.534 | 20.878 | 2.234 | 1.582* | 9.347** |
| GD (mm) | 912.724 | 7471.747 | 827.718 | 1.103 | 9.027** |
| CW (m²) | 37.515 | 118.912 | 31.295 | 1.199 | 3.800** |
| FFY (kg) | 3.392 | 12.007 | 3.712 | 0.914 | 3.235** |
| TSFW (g) | 504.343 | 2815.821 | 475.554 | 1.061 | 5.921** |
| TSDW (g) | 177.661 | 306.113 | 89.483 | 1.985** | 3.421** |
| WC (%) | 33.228 | 140.933 | 27.434 | 1.211 | 5.137** |
| PR (%) | 10.812 | 65.814 | 13.699 | 0.789 | 4.804** |
| P:K | 1.001 | 4.413 | 1.024 | 0.977 | 4.309** |
| EO content (%) | 1.037 | 1.047 | 0.484 | 2.142* | 2.163** |
| CitrP (%) | 59.739 | 16.279 | 4.408 | 13.552** | 3.693** |
| NeralP (%) | 24.769 | 7.894 | 0.557 | 44.477** | 14.176** |
| GeranialP (%) | 8.576 | 4.870 | 3.456 | 2.481** | 1.409 |
| 4M3PP (%) | 0.964 | 3.077 | 1.200 | 0.803 | 2.563** |
| 1CCP4OP (%) | 2.788 | 11.615 | 3.927 | 0.710 | 2.957** |
| SabP (%) | 1.612 | 6.871 | 1.103 | 1.461 | 6.227** |
| D-LP (%) | 23.379 | 12.007 | 4.655 | 5.022** | 2.580** |
| LinalP (%) | 0.052 | 0.139 | 0.040 | 1.311 | 3.497** |
| CitroP (%) | 8.517 | 15.375 | 3.657 | 2.329** | 4.205** |
| 3,7-DP (%) | 12.304 | 38.384 | 6.289 | 1.956* | 6.103** |

TH, tree height; GD, ground diameter; CW, crown width; FFY, fresh fruit yield; TSDW, thousand seed dry weight; TSFW, thousand seed fresh weight; WC, water content; PR, pericarp ratio; P:K, pericarp:kernel; EO content, essential oil content; CitrP, citral proportion; NeralP, the proportion of neral; GeranialP, the proportion of geranial; 4M3PP, the proportion of 4-methyl-3-pentenal; 1CCP4OP, proportion of 1-(cyclopanecarbonyl)Piperidin-4-one; SabP, the proportion of Sabinene; D-LP, the proportion of D-limonene; LinalP, the proportion of linalool; CitroP, the proportion of citronellal; 3,7-DP, the proportion of 3,7-dimethyl-3,6-octadienal; * indicates that there is significant difference at 0.05 level; ** indicates that there is significant difference at 0.01 level.

Table S4 CV of growth traits of *L. cubeba* within provenances

| Provenance | TH (m) | GD (mm) | CW (m ²) | Mean |
|------------|--------|---------|----------------------|--------|
| PX | 29.49% | 73.89% | 102.51% | 68.63% |
| LH | 25.93% | 24.97% | 62.61% | 37.84% |
| YX | 33.25% | 49.94% | 81.92% | 55.04% |
| SC | 28.52% | 25.63% | 51.70% | 35.28% |
| AF | 20.05% | 24.46% | 66.42% | 36.98% |
| JA | 17.79% | 23.86% | 47.00% | 29.55% |
| TH | 12.96% | 14.03% | 51.66% | 26.22% |
| WA | 19.28% | 53.54% | 53.27% | 42.03% |
| XS | 33.10% | 37.00% | 57.27% | 42.46% |
| WN | 31.96% | 26.56% | 69.29% | 42.60% |
| LS | 39.00% | 67.70% | 93.75% | 66.82% |
| LA | 20.19% | 17.86% | 57.94% | 32.00% |
| FZ | 32.65% | 33.92% | 70.16% | 45.58% |
| LC | 30.57% | 39.21% | 56.47% | 42.08% |
| SY | 37.42% | 48.72% | 44.71% | 43.62% |
| QN | 33.34% | 45.02% | 61.66% | 46.67% |
| DY | 27.29% | 55.80% | 75.26% | 52.78% |
| XF | 25.12% | 38.88% | 50.92% | 38.31% |
| HC | 31.81% | 26.83% | 62.05% | 40.23% |
| YD | 22.01% | 26.58% | 63.71% | 37.43% |
| XG | 25.64% | 18.71% | 60.39% | 34.91% |
| ND | 22.08% | 22.50% | 39.54% | 28.04% |
| RJ | 56.72% | 54.68% | 79.93% | 63.78% |
| FL | 23.62% | 26.58% | 40.44% | 30.21% |
| GX | 36.19% | 66.41% | 92.86% | 65.15% |
| LP | 31.26% | 49.63% | 79.81% | 53.57% |
| YS | 36.99% | 68.60% | 84.11% | 63.23% |
| Mean | 29.05% | 39.32% | 65.09% | 44.49% |

TH, tree height; GD, ground diameter; CW, crown width.

Table S5 CV of fruit phenotypic traits of *L. cubeba* within provenances

| Provenance | FFY (kg·tree ⁻¹) | TSFW (g) | TSDW (g) | WC (%) | PR (%) | P:K | Mean |
|------------|------------------------------|----------|----------|--------|--------|--------|--------|
| PX | 268.32% | 15.98% | 17.71% | 6.99% | 5.19% | 28.45% | 57.11% |
| LH | 47.40% | 19.01% | 20.38% | 8.34% | 4.76% | 27.61% | 21.25% |
| YX | 89.43% | 14.95% | 26.96% | 14.34% | 3.61% | 21.99% | 28.55% |
| SC | 63.69% | 10.38% | 17.14% | 4.95% | 2.56% | 13.89% | 18.77% |
| AF | 110.33% | 17.71% | 20.92% | 9.34% | 5.95% | 30.53% | 32.46% |
| JA | 46.67% | 14.62% | 17.76% | 10.82% | 4.29% | 25.09% | 19.88% |
| TH | 63.71% | 15.37% | 22.89% | 8.04% | 4.01% | 15.16% | 21.53% |
| WA | 55.27% | 14.55% | 18.12% | 11.78% | 5.51% | 29.76% | 22.50% |
| XS | 80.60% | 18.78% | 18.91% | 5.95% | 5.22% | 27.80% | 26.21% |
| WN | 97.45% | 22.84% | 27.23% | 8.07% | 5.53% | 35.16% | 32.71% |
| LS | 102.44% | 11.53% | 20.37% | 11.09% | 5.91% | 36.28% | 31.27% |
| LA | 90.56% | 19.08% | 20.01% | 7.72% | 3.26% | 16.39% | 26.17% |
| FZ | 67.44% | 16.21% | 20.06% | 7.56% | 3.51% | 19.95% | 22.45% |
| LC | 90.59% | 17.88% | 25.13% | 8.11% | 4.01% | 19.72% | 27.57% |
| SY | 44.23% | 17.01% | 19.77% | 7.61% | 3.81% | 25.97% | 19.73% |
| QN | 63.60% | 17.30% | 18.11% | 9.18% | 4.20% | 23.57% | 22.66% |
| DY | 231.75% | 20.61% | 25.65% | 7.82% | 5.11% | 25.59% | 52.76% |
| XF | 64.45% | 12.88% | 16.31% | 6.94% | 4.97% | 20.88% | 21.07% |
| HC | 79.99% | 14.91% | 19.97% | 7.68% | 4.43% | 23.01% | 25.00% |
| YD | 67.39% | 20.01% | 17.21% | 7.33% | 4.92% | 22.03% | 23.15% |
| XG | 37.27% | 22.74% | 18.98% | 8.83% | 6.60% | 33.35% | 21.30% |
| ND | 45.49% | 19.41% | 23.24% | 10.63% | 4.39% | 25.10% | 21.38% |
| RJ | 79.25% | 13.52% | 14.43% | 8.54% | 4.35% | 21.94% | 23.67% |
| FL | 86.83% | 16.71% | 21.09% | 5.87% | 3.83% | 26.41% | 26.79% |
| GX | 137.10% | 15.67% | 19.22% | 6.15% | 4.49% | 22.71% | 34.22% |
| LP | 162.78% | 16.81% | 15.09% | 6.06% | 4.21% | 21.99% | 37.82% |
| YS | 120.16% | 14.49% | 15.49% | 6.56% | 4.53% | 22.23% | 30.58% |
| Mean | 92.38% | 16.70% | 19.93% | 8.23% | 4.56% | 24.54% | 27.72% |

FFY, fresh fruit yield; TSFW, thousand seed fresh weight; TSDW, thousand seed dry weight; WC, water content; PR, pericarp ratio; P:K, pericarp:kernel.

Table S6 CV of EO content and components of *L. cubeba* within provenances

| Provenance | EO content (%) | CitrP (%) | NeralP (%) | GeranialP (%) | 4M3PP (%) | 1CCP4OP (%) | SabP (%) | D-LP (%) | LinalP (%) | CitroP (%) | 3,7-DP (%) | Mean |
|------------|----------------|-----------|------------|---------------|-----------|-------------|----------|----------|------------|------------|------------|--------|
| PX | 30.37% | 5.58% | 7.35% | 5.09% | 119.40% | 119.89% | 76.96% | 52.27% | 12.73% | 61.75% | 79.17% | 51.87% |
| LH | 16.44% | 2.82% | 5.19% | 6.34% | 105.59% | 93.29% | — | 33.41% | 16.59% | 48.34% | 15.60% | 31.24% |
| YX | 14.22% | 4.15% | 5.37% | 4.30% | 79.63% | 95.54% | 36.63% | 40.18% | 7.92% | 14.25% | 10.67% | 28.44% |
| AF | 14.17% | 2.71% | 3.60% | 2.13% | 56.62% | 55.50% | 72.92% | 19.33% | 5.28% | 27.36% | 26.92% | 26.05% |
| JA | 5.37% | 0.73% | 0.48% | 1.34% | — | — | 21.35% | 8.84% | 4.13% | 36.45% | 17.58% | 8.75% |
| TH | 12.40% | 1.94% | 1.55% | 3.79% | — | — | 245.00% | 10.49% | 9.56% | 21.10% | 15.83% | 29.24% |
| WA | 19.96% | 6.05% | 5.98% | 7.39% | 175.50% | 174.32% | 85.32% | 36.50% | 2.34% | 31.93% | 18.08% | 51.22% |
| XS | 11.24% | 2.48% | 1.05% | 5.74% | 62.77% | 74.82% | 26.89% | 39.84% | 1.76% | 18.28% | 16.71% | 23.78% |
| WN | 16.55% | 2.41% | 2.22% | 4.53% | 173.23% | 173.21% | 97.97% | 17.61% | 2.76% | 20.72% | 18.76% | 48.18% |
| LC | 23.05% | 5.08% | 5.72% | 5.90% | 117.71% | 116.31% | 98.76% | 32.58% | 18.29% | 74.13% | 99.48% | 54.27% |
| QN | 23.29% | 5.88% | 6.36% | 5.61% | 62.78% | 55.85% | 48.72% | 32.48% | 8.19% | 110.88% | 76.12% | 39.65% |
| DY | 16.51% | 2.93% | 3.62% | 3.71% | 52.75% | 54.20% | 41.29% | 38.00% | 11.13% | 38.39% | 264.58% | 47.92% |
| XF | 22.16% | 4.81% | 6.71% | 4.78% | 112.02% | 107.65% | 32.22% | 35.43% | 9.23% | 59.55% | 134.04% | 48.05% |
| HC | 27.43% | 3.80% | 3.60% | 4.98% | 88.18% | 89.00% | 52.74% | 31.30% | 3.93% | 100.38% | 78.52% | 43.99% |
| YD | 22.57% | 3.65% | 4.72% | 3.18% | 68.93% | 69.18% | 38.14% | 40.27% | 8.13% | 84.71% | 76.72% | 38.20% |
| ND | 42.56% | 4.83% | 4.09% | 6.12% | 182.56% | 184.48% | 73.69% | 93.74% | 18.84% | 34.90% | 41.69% | 62.50% |
| RJ | 22.64% | 3.28% | 1.68% | 4.75% | 90.95% | 90.44% | 29.28% | 14.33% | 7.73% | 50.49% | 12.54% | 29.83% |
| FL | 7.81% | 4.69% | 2.09% | 7.19% | 208.50% | 173.19% | 36.46% | 34.51% | 6.15% | 79.50% | 16.29% | 52.40% |
| GX | 19.89% | 4.43% | 5.06% | 5.92% | 86.10% | 86.61% | 44.57% | 28.64% | 11.10% | 45.16% | 152.16% | 44.51% |
| LP | 7.12% | 6.55% | 6.95% | 6.60% | 264.57% | 264.58% | 131.43% | 65.12% | 17.35% | 66.93% | 9.54% | 76.98% |
| YS | 17.89% | 3.82% | 4.93% | 2.88% | 115.56% | 115.53% | 6.58% | 16.57% | 6.71% | 11.76% | 5.24% | 27.95% |
| Mean | 18.74% | 3.93% | 4.21% | 4.87% | 105.87% | 104.46% | 61.76% | 34.35% | 9.04% | 49.38% | 56.49% | 41.19% |

EO content, essential oil content; CitrP, citral proportion; NeralP, the proportion of neral; GeranialP, the proportion of geranial; 4M3PP, the proportion of 4-methyl-3-pentenal; 1CCP4OP, proportion of 1-(cyclopanecarbonyl)Piperidin-4-one; SabP, the proportion of Sabinene; D-LP, the proportion of D-limonene; LinaP, the proportion of linalool; CitroP, the proportion of citronellal; 3,7-DP, the proportion of 3,7-dimethyl-3,6-octadienal.

Table S7 Multiple comparison on growth traits of *L. cubeba* between provenances

| Provenance | TH (m) | GD (mm) | CW (m ²) |
|------------|---------------|------------------|----------------------|
| PX | 3.40±0.20fg | 35.12±5.19h | 4.72±0.97g |
| LH | 3.12±0.16g | 28.04±1.40h | 4.19±0.52g |
| YX | 5.05±0.35cde | 48.61±5.06efgh | 8.00±1.37cdefg |
| SC | 5.20±0.66bcde | 51.80±5.94defgh | 8.80±2.03bcdefg |
| AF | 3.74±0.15efg | 40.50±2.02gh | 4.97±0.67g |
| JA | 5.02±0.25cde | 46.77±3.09efgh | 6.50±0.85defg |
| TH | 5.17±0.17bcde | 50.88±1.78defgh | 7.38±0.95defg |
| WA | 6.11±0.27b | 69.79±8.57bcd | 10.84±1.33abc |
| XS | 5.15±0.49bcde | 85.83±9.17b | 8.42±1.39bcdefg |
| WN | 4.10±0.44efg | 69.44±6.15bcde | 6.68±1.54defg |
| LS | 4.24±0.52def | 81.50±17.45b | 10.80±3.20abcd |
| LA | 4.25±0.27def | 41.10±2.32fgh | 4.80±0.88g |
| FZ | 3.06±0.27g | 30.93±2.80h | 3.86±0.72g |
| LC | 5.06±0.35cde | 57.54±5.18cdef | 9.05±1.17bcdef |
| SY | 5.92±0.99bc | 69.00±15.03bcdef | 5.88±1.17fg |
| QN | 5.55±0.36bc | 45.95±4.06fgh | 7.46±0.90defg |
| DY | 5.80±0.28bc | 40.59±4.00gh | 8.11±1.08cdefg |
| XF | 4.20±0.19ef | 28.67±2.03h | 5.99±0.56fg |
| HC | 5.50±0.36bc | 53.71±2.94defg | 9.66±1.22abcde |
| YD | 7.07±0.30a | 71.69±3.67bc | 7.38±0.91defg |
| XG | 4.02±0.46efg | 50.00±4.18defgh | 3.06±0.83g |
| ND | 5.33±0.25bcd | 53.70±2.52defg | 5.36±0.44g |
| RJ | 4.96±0.60cde | 58.41±6.81cdef | 6.16±1.05fg |
| FL | 4.22±0.20ef | 45.213±2.45fgh | 4.41±0.36g |
| GX | 5.96±0.38b | 71.83±8.43bc | 11.24±1.84ab |
| LP | 3.89±0.25efg | 53.58±5.43defg | 6.48±1.06efg |
| YS | 5.51±0.41bc | 109.80±15.07a | 12.68±2.13a |

TH, tree height; GD, ground diameter; CW, crown width; Different small letters in the Fig. indicate that there is a significant difference in the same index between the provenances ($P<0.05$).

Table S8 Multiple comparison on fruit phenotype traits of *L. cubeba* between provenances

| Provenance | FFY (kg·tree ⁻¹) | TSFW (g) | TSDW (g) | WC (%) | PR (%) | P:K |
|------------|------------------------------|-----------------|-----------------|-----------------|----------------|--------------|
| PX | 1.38±0.74bc | 122.50±3.92c | 42.23±1.50ef | 65.34±0.91ab | 79.39±0.82cde | 4.08±0.23cd |
| LH | 0.36±0.03c | 130.81±4.97bc | 43.63±1.78ef | 66.42±1.11a | 78.57±0.75cdef | 3.84±0.21cde |
| YX | 0.94±0.17bc | 129.99±4.05bc | 49.10±2.76bcdef | 62.16±1.86cde | 81.31±0.61abc | 4.51±0.21bc |
| SC | 0.77±0.22c | 147.03±6.82ab | 51.36±3.94bcde | 65.21±1.44abc | 82.04±0.94abc | 4.64±0.29abc |
| AF | 0.99±0.22bc | 109.30±3.87de | 41.54±1.74f | 61.86±1.16cde | 77.36±0.92efg | 3.63±0.22def |
| JA | 0.38±0.05c | 122.49±4.97cde | 46.64±2.30cdef | 61.58±1.85cde | 79.75±0.95bcde | 4.10±0.29bcd |
| TH | 0.77±0.12c | 127.16±4.89bc | 55.15±3.16ab | 56.93±1.14g | 76.35±0.76fg | 3.31±0.13ef |
| WA | 0.61±0.08c | 138.63±4.63abc | 57.44±2.39a | 58.24±1.57efg | 79.53±1.01cde | 4.15±0.28bcd |
| XS | 0.72±0.17c | 136.29±7.39bc | 45.85±2.50def | 66.13±1.14ab | 80.12±1.21bcd | 4.27±0.34bcd |
| WN | 0.85±0.28bc | 144.14±10.97ab | 52.08±4.73abcd | 63.99±1.72abcd | 79.68±1.47bcde | 4.21±0.49bcd |
| LS | 0.49±0.16c | 146.11±5.33ab | 50.97±3.28bcde | 64.89±2.28abc | 80.26±1.50bcd | 4.41±0.51bc |
| LA | 0.54±0.15c | 125.47±7.57bc | 50.86±3.22bcde | 59.33±1.45defg | 77.51±0.80defg | 3.56±0.18def |
| FZ | 0.27±0.05c | 136.78±5.92bc | 49.39±2.65bcdef | 63.81±1.29abcd | 82.31±0.77ab | 4.84±0.26ab |
| LC | 2.21±0.46ab | 127.66±5.24bc | 49.29±2.84bcdef | 61.59±1.15cde | 78.57±0.72cdef | 3.78±0.17cde |
| SY | 0.38±0.08c | 139.03±10.58abc | 44.28±3.92def | 67.99±2.31a | 84.38±1.44a | 5.65±0.66a |
| QN | 0.63±0.08c | 129.23±4.38bc | 45.11±1.60def | 64.68±1.16abc | 79.08±0.65cde | 3.93±0.18cde |
| DY | 1.47±0.60bc | 132.60±4.83bcd | 50.66±2.30bcde | 61.92±0.86cde | 78.67±0.71cde | 3.90±0.18cde |
| XF | 0.57±0.07c | 120.77±2.84cd | 46.24±1.38def | 61.67±0.78cde | 79.45±0.72cde | 4.03±0.15cde |
| HC | 0.68±0.11c | 129.25±3.93bc | 48.27±1.97cdef | 62.64±0.98bcde | 80.05±0.72bcd | 4.19±0.20bcd |
| YD | 0.571±0.07c | 103.14±3.97e | 43.28±1.43ef | 57.75±0.81fg | 74.93±0.71g | 3.09±0.13f |
| XG | 0.24±0.04c | 137.44±13.98abc | 50.29±4.27bcdef | 62.97±2.49abcde | 79.11±2.34cde | 4.06±0.61cde |
| ND | 0.46±0.04c | 121.32±4.71cd | 47.68±2.22cdef | 60.48±1.29cdef | 79.14±0.69cde | 3.95±0.20cde |
| RJ | 0.55±0.09c | 118.57±3.42cd | 44.59±1.37def | 62.08±1.13cde | 78.84±0.73cde | 3.86±0.18cde |
| FL | 0.64±0.11c | 149.52±5.10a | 49.64±2.14bcdef | 66.86±0.80a | 83.34±0.65a | 5.26±0.28a |
| GX | 2.65±0.64a | 132.64±3.67bc | 46.53±1.58def | 64.90±0.71abc | 79.43±0.63cde | 4.08±0.16cd |
| LP | 2.14±0.71ab | 153.55±5.27a | 53.04±1.63abc | 65.12±0.81abc | 81.04±0.70abc | 4.45±0.20bc |
| YS | 2.89±0.69a | 137.08±3.97bc | 51.57±1.60bcd | 62.22±0.82cde | 79.52±0.72cde | 4.04±0.18cde |

FFY, fresh fruit yield; TSDW, thousand seed dry weight; TSFW, thousand seed fresh weight; WC, water content; PR, pericarp ratio; P:K, pericarp:kernel; Different small letters in the Fig. indicate that there is a significant difference in the same index between the provenances ($P<0.05$).

Table S9 Multiple comparison of EO content and components of *L. cubeba* between provenances

| Provenances | EO content (%) | CitrP (%) | NeralP (%) | GeranialP (%) | 4M3PP (%) | 1CCP4OP (%) | SabP (%) | D-LP (%) | LinalP (%) | CitroP (%) | 3,7-DP (%) |
|-------------|----------------|--------------|---------------|---------------|---------------|--------------|---------------|---------------|--------------|---------------|----------------|
| PX | 3.15±0.34bc | 73.98±1.46bc | 35.89±0.93bc | 38.09±0.69c | 0.97±0.41cde | 1.74±0.74bcd | 0.98±0.27efg | 7.72±1.43abc | 2.07±0.09a | 4.10±0.90abcd | 4.16±1.16defg |
| LH | 2.56±0.17c | 75.76±0.87bc | 34.91±0.74cd | 40.86±1.06cd | 0.43±0.18de | 0.86±0.33d | — | 6.25±0.85bcd | 1.67±0.11cd | 1.92±0.38cd | 7.34±0.47abc |
| YX | 3.21±0.14bc | 74.48±0.98bc | 35.48±0.6bcd | 39.01±0.53a | 0.64±0.16de | 0.80±0.24d | 2.51±0.29bc | 6.06±0.77cd | 1.80±0.05bcd | 1.72±0.08e | 8.11±0.27ab |
| AF | 3.33±0.18abc | 73.97±0.76bc | 35.72±0.49bc | 38.24±0.31ab | 0.83±0.18cde | 1.52±0.32cd | 0.79±0.22efg | 8.95±0.65ab | 1.82±0.04bcd | 2.53±0.26de | 6.85±0.70abcde |
| JA | 3.95±0.12ab | 75.6±0.32bc | 35.95±0.10bc | 39.64±0.31a | — | — | 1.79±0.22cde | 7.20±0.37abcd | 2.13±0.05a | 3.00±0.63bcde | 7.09±0.72abcde |
| TH | 3.39±0.17abc | 74.62±0.59bc | 36.23±0.23bc | 38.39±0.59ab | — | — | 0.10±0.10g | 7.45±0.32abcd | 2.12±0.08a | 1.86±0.16e | 9.29±0.60a |
| WA | 3.46±0.31abc | 74.62±2.02bc | 36.09±0.96bc | 38.53±1.27ab | 0.50±0.39de | 0.91±0.71d | 3.24±1.24b | 7.95±1.30abc | 1.64±0.02d | 0.66±0.09e | 4.93±0.4cdefg |
| XS | 2.95±0.19bc | 74.61±1.07bc | 35.80±0.22bc | 38.81±1.29ab | 1.11±0.40bcde | 1.89±0.82bcd | 1.69±0.26cdef | 8.60±1.98abc | 1.58±0.02d | 2.03±0.21de | 6.39±0.62abcde |
| WN | 2.85±0.27bc | 72.57±1.01c | 32.68±0.42d | 39.89±1.04a | 0.19±0.19de | 0.35±0.35d | 0.58±0.33efg | 7.37±0.75abcd | 1.94±0.03abc | 1.49±0.18e | 5.10±0.55cdefg |
| LC | 3.57±0.24ab | 72.64±1.06c | 35.00±0.58cd | 37.65±0.64ab | 1.05±0.36cde | 1.94±0.65bcd | 1.91±0.55cde | 9.27±0.87a | 1.80±0.10bcd | 4.07±0.87bcd | 3.94±1.13efg |
| QN | 3.53±0.29abc | 75.17±1.56bc | 36.95±0.83b | 38.22±0.76ab | 2.43±0.54a | 4.88±0.96a | 2.50±0.43bc | 6.55±0.75bcd | 1.65±0.05d | 2.55±1.00de | 1.73±0.46gh |
| DY | 3.98±0.25a | 76.31±0.84b | 37.32±0.51ab | 38.99±0.55b | 1.80±0.36abc | 3.39±0.70abc | 1.74±0.27cde | 5.68±0.81cd | 1.80±0.08bcd | 6.04±0.88a | 0.98±0.98h |
| XF | 4.09±0.23a | 76.22±0.92b | 36.94±0.62b | 39.29±0.47a | 1.35±0.38bcd | 2.38±0.64bcd | 1.67±0.13def | 6.15±0.54cd | 1.78±0.04bcd | 4.88±0.73ab | 2.84±0.95fgh |
| HC | 3.55±0.37ab | 76.63±1.10ab | 37.05±0.50b | 39.58±0.75a | 1.09±0.36bcde | 2.09±0.70bcd | 2.64±0.53bc | 6.45±0.76bcd | 1.79±0.03bcd | 2.87±1.09cde | 4.09±1.21defg |
| YD | 3.99±0.37a | 75.20±1.12bc | 35.96±0.69bc | 39.25±0.51a | 0.81±0.23cde | 1.43±0.40cd | 2.91±0.45bc | 7.25±1.19abcd | 1.70±0.06cd | 2.97±1.03bcde | 5.12±1.6cdef |
| ND | 3.60±0.77ab | 80.61±1.95a | 39.57±0.81a | 41.05±1.26a | 1.12±1.02bcde | 2.42±2.24bcd | 1.93±0.71bc | 4.09±1.92d | 1.74±0.16bcd | 0.69±0.12e | 4.47±0.93cdefg |
| RJ | 3.54±0.46abc | 74.5±1.41bc | 35.52±0.34bcd | 38.99±1.07ab | 0.21±0.11de | 0.38±0.20d | 5.02±0.85a | 7.71±0.64abcd | 1.64±0.07d | 0.94±0.27e | 6.27±0.45abcde |
| FL | 3.65±0.12ab | 77.45±1.48ab | 37.16±0.32ab | 40.28±1.18a | 0.33±0.28de | 0.28±0.20d | 1.12±0.17defg | 5.76±0.81cd | 1.65±0.04d | 2.17±0.70de | 5.87±0.39bcde |
| GX | 3.67±0.23ab | 75.67±1.06bc | 36.87±0.59b | 38.80±0.73ab | 2.01±0.55ab | 3.46±0.95ab | 2.02±0.29cd | 5.18±0.47cd | 1.85±0.07bc | 4.60±0.66abc | 2.36±1.14gh |
| LP | 3.46±0.09abc | 75.05±1.86bc | 35.91±0.94bc | 39.14±0.98a | 0.07±0.07e | 0.12±0.12d | 0.29±0.14fg | 8.42±2.07abc | 1.96±0.13ab | 1.33±0.34e | 8.47±0.31ab |
| YS | 4.19±0.37a | 75.55±1.44bc | 36.05±0.89bc | 39.50±0.57a | 0.29±0.17de | 0.42±0.24d | 2.41±0.08bcd | 6.27±0.52bcd | 1.63±0.05d | 1.64±0.10e | 7.33±0.19abcd |

EO content, essential oil content; CitrP, citral proportion; NeralP, the proportion of neral; GeranialP, the proportion of geranial; 4M3PP, the proportion of 4-methyl-3-pentenal; 1CCP4OP, proportion of 1-(cyclopanecarbonyl)Piperidin-4-one; SabP, the proportion of Sabinene; D-LP, the proportion of D-limonene; LinalP, the proportion of linalool; CitroP, the proportion of citronellal; 3,7-DP, the proportion of 3,7-dimethyl-3,6-octadienal. Different small letters in the Fig. indicate that there is a significant difference in the same index between the provenances ($P<0.05$).

Table S10 Path analysis of environmental factors for FFY of *L. cubeba*

| Traits | Direct path coefficient | Indirect path coefficient | | | | | | | | |
|--------------------------|-------------------------|---------------------------|--------|--------|--------|--------|--------|--------|-------|--------|
| | | X_1 | X_2 | X_3 | X_4 | X_5 | X_6 | X_7 | X_8 | Sum |
| X_1 (Longitude, °E) | 0.674 | | -0.076 | 0.286 | -0.185 | 0.105 | 0.154 | -0.381 | 0.079 | -0.020 |
| X_2 (Latitude, °N) | 0.505 | -0.057 | | 0.103 | 0.344 | 0.042 | 0.162 | -0.036 | 0.197 | 0.755 |
| X_3 (Elevation, m) | 0.206 | 0.087 | 0.042 | | 0.018 | 0.074 | 0.047 | -0.032 | 0.011 | 0.247 |
| X_4 (AAT, °C) | 0.452 | -0.124 | 0.308 | 0.040 | | 0.149 | -0.061 | 0.057 | 0.222 | 0.591 |
| X_5 (AAMaxT, °C) | 0.021 | 0.003 | 0.002 | 0.007 | 0.007 | | 0.001 | 0.000 | 0.005 | 0.024 |
| X_6 (AAMinT, °C) | 0.960 | 0.219 | 0.308 | 0.217 | -0.131 | 0.024 | | 0.254 | 0.396 | 1.288 |
| X_7 (AAR, mm) | 0.712 | -0.403 | -0.051 | -0.110 | 0.090 | -0.016 | 0.189 | | 0.214 | -0.089 |
| X_8 (AARH, %) | 0.484 | 0.057 | 0.189 | 0.081 | 0.238 | 0.109 | 0.200 | 0.145 | | 1.019 |

AAT, annual average temperature; AAMaxT, annual average maximum temperature; AAMinT, annual average minimum temperature; AARH, annual average relative humidity; AAR, annual average rainfall.

Table S11 Path analysis of environmental factors for EO content of *L. cubeba*

| Traits | Direct path coefficient | Indirect path coefficient | | | | | | | | Sum |
|--------------------------|-------------------------|---------------------------|--------|--------|--------|--------|-------|--------|-------|--------|
| | | X_1 | X_2 | X_3 | X_4 | X_5 | X_6 | X_7 | X_8 | |
| X_1 (Longitude, °E) | 0.409 | | -0.046 | 0.173 | -0.112 | 0.064 | 0.093 | -0.231 | 0.048 | -0.012 |
| X_2 (Latitude, °N) | 0.388 | -0.044 | | 0.079 | 0.265 | 0.033 | 0.125 | -0.028 | 0.151 | 0.580 |
| X_3 (Elevation, m) | 0.377 | 0.160 | 0.077 | | 0.034 | 0.135 | 0.085 | -0.058 | 0.063 | 0.495 |
| X_4 (AAT, °C) | 0.002 | -0.001 | 0.001 | 0.000 | | 0.001 | 0.000 | 0.000 | 0.001 | 0.003 |
| X_5 (AAMaxT, °C) | 0.200 | 0.031 | 0.017 | 0.071 | 0.066 | | 0.005 | -0.005 | 0.045 | 0.231 |
| X_6 (AAMinT, °C) | 0.401 | 0.091 | 0.129 | 0.091 | -0.055 | 0.010 | | 0.106 | 0.166 | 0.538 |
| X_7 (AAR, mm) | 0.219 | -0.124 | -0.016 | -0.034 | 0.028 | -0.005 | 0.058 | | 0.066 | -0.027 |
| X_8 (AARH, %) | 0.002 | 0.000 | 0.001 | 0.000 | 0.001 | 0.000 | 0.001 | 0.001 | | 0.004 |

AAT, annual average temperature; AAMaxT, annual average maximum temperature; AAMinT, annual average minimum temperature; AARH, annual average relative humidity; AAR, annual average rainfall.

| Table S12 Path analysis of environmental factors for CitrP of <i>L. cubeba</i> | | | | | | | | | | |
|--|-------------------------|---------------------------|--------|--------|--------|--------|--------|--------|-------|--------|
| Traits | Direct path coefficient | Indirect path coefficient | | | | | | | | |
| | | X_1 | X_2 | X_3 | X_4 | X_5 | X_6 | X_7 | X_8 | Sum |
| X_1 (Longitude, °E) | 0.043 | | -0.005 | 0.018 | -0.012 | 0.007 | 0.010 | -0.024 | 0.005 | -0.001 |
| X_2 (Latitude, °N) | 0.237 | -0.027 | | 0.048 | 0.162 | 0.020 | 0.076 | -0.017 | 0.092 | 0.355 |
| X_3 (Elevation, m) | 0.043 | 0.018 | 0.009 | | 0.004 | 0.015 | 0.010 | -0.007 | 0.007 | 0.056 |
| X_4 (AAT, °C) | 0.507 | -0.139 | 0.346 | 0.045 | | 0.167 | -0.069 | 0.064 | 0.249 | 0.663 |
| X_5 (AAMaxT, °C) | 0.493 | 0.077 | 0.041 | 0.176 | 0.162 | | 0.012 | -0.011 | 0.111 | 0.569 |
| X_6 (AAMinT, °C) | 0.885 | 0.202 | 0.284 | 0.200 | -0.120 | 0.022 | | 0.235 | 0.366 | 1.188 |
| X_7 (AAR, mm) | 0.663 | -0.375 | -0.048 | -0.103 | 0.084 | -0.015 | 0.176 | | 0.199 | -0.083 |
| X_8 (AARH, %) | 0.154 | 0.018 | 0.060 | 0.026 | 0.076 | 0.035 | 0.064 | 0.046 | | 0.324 |

AAT, annual average temperature; AAMaxT, annual average maximum temperature; AAMinT, annual average minimum temperature; AARH, annual average relative humidity; AAR, annual average rainfall.

| Table S13 Results on detrended correspondence analysis of environmental factors | | | | |
|---|---------------|---------------|---------------|---------------|
| Statistic | <i>Axis 1</i> | <i>Axis 2</i> | <i>Axis 3</i> | <i>Axis 4</i> |
| Eigenvalues | 0.0138 | 0.0029 | 0.0016 | 0.0005 |
| Explained variation (cumulative) | 56.37 | 68.23 | 74.91 | 76.88 |
| Gradient length | 0.34 | 0.27 | 0.24 | 0.22 |
| Pseudo-canonical correlation (suppl.) | 0.7397 | 0.5588 | 0.8776 | 0.8010 |

The gradient length of sorting axis were all less than 3, so that the raw data can be used by the redundancy analysis belonging to the linear model.

| Table S14 The summary results of interactive-forward-selection of redundancy analysis | | | | |
|---|---------------|---------------|---------------|---------------|
| Statistic | <i>Axis 1</i> | <i>Axis 2</i> | <i>Axis 3</i> | <i>Axis 4</i> |
| Eigenvalues | 0.1699 | 0.1174 | 0.0853 | 0.0593 |
| Explained variation (cumulative) | 16.99 | 28.72 | 37.25 | 43.19 |
| Pseudo-canonical correlation | 0.91 | 0.78 | 0.76 | 0.71 |
| Explained fitted variation (cumulative) | 32.29 | 54.61 | 70.83 | 82.11 |

The analysis methods of redundancy analysis were interactive-forward-selection and forward selection. All environmengtal factors explained 52.6% of phenotypic variations of *L. cubeba*.

Table S15 The results of forward selection in redundancy analysis

| NO. | Name | Explains (%) | Contribution (%) | Pseudo - <i>F</i> | <i>P</i> - value |
|-----|-----------|--------------|------------------|-------------------|------------------|
| 1 | Latitude | 12.5 | 23.8 | 2.7 | 0.004 |
| 2 | Longitude | 10.4 | 19.8 | 2.4 | 0.010 |
| 3 | AAMaxT | 6.3 | 12.0 | 1.5 | 0.138 |
| 4 | AAMinT | 6.2 | 11.7 | 1.5 | 0.154 |
| 5 | Elevation | 5.2 | 10.0 | 1.3 | 0.192 |
| 6 | AAT | 4.4 | 8.3 | 1.1 | 0.344 |
| 7 | AARH | 3.9 | 7.5 | 1.0 | 0.398 |
| 8 | AAR | 3.7 | 6.9 | 0.9 | 0.530 |

Three geographic features and five climate conditions were selected to redundancy analysis; AAT, annual average temperature; AAMaxT, annual average maximum temperature; AAMinT, annual average minimum temperature; AARH, annual average relative humidity; AAR, annual average rainfall.

Table S16 Principal component analysis of phenotypic diversity in *L. cubeba*

| Phenotypic traits | Principle component | | | | | | |
|-------------------------------|---------------------|--------|--------|--------|--------|--------|--------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| TH (m) | 0.138 | 0.029 | -0.014 | 0.713 | 0.119 | -0.248 | 0.114 |
| GD (mm) | 0.437 | -0.276 | 0.059 | 0.700 | 0.081 | 0.013 | -0.123 |
| CW (m ²) | 0.259 | -0.231 | 0.105 | 0.714 | 0.184 | 0.040 | -0.238 |
| FFY (kg·tree ⁻¹) | 0.191 | -0.374 | -0.014 | 0.478 | 0.232 | 0.277 | -0.392 |
| TSFW (g) | 0.373 | 0.022 | 0.508 | 0.107 | -0.664 | 0.312 | 0.067 |
| TSDW (g) | 0.575 | 0.171 | 0.009 | 0.210 | -0.626 | 0.386 | 0.195 |
| WC (%) | -0.365 | -0.239 | 0.726 | -0.147 | 0.021 | -0.162 | -0.220 |
| PR (%) | -0.097 | -0.122 | 0.914 | 0.048 | 0.119 | 0.023 | 0.189 |
| P:K | -0.139 | -0.127 | 0.912 | 0.063 | 0.121 | -0.005 | 0.192 |
| EO content (%) | 0.032 | 0.450 | -0.355 | 0.312 | 0.197 | 0.251 | 0.388 |
| CitrP (%) | 0.445 | 0.827 | 0.192 | -0.030 | 0.192 | -0.102 | -0.069 |
| NeralP (%) | 0.114 | 0.846 | 0.202 | 0.074 | 0.244 | 0.097 | 0.057 |
| GeranialP (%) | 0.639 | 0.553 | 0.122 | -0.124 | 0.081 | -0.270 | -0.174 |
| 4M3PP (%) | -0.780 | 0.237 | -0.059 | 0.334 | -0.332 | -0.128 | -0.208 |
| 1CCP4OP (%) | -0.772 | 0.257 | -0.041 | 0.318 | -0.340 | -0.148 | -0.210 |
| SabP (%) | -0.289 | -0.141 | 0.004 | 0.355 | 0.129 | -0.239 | 0.660 |
| D-LP (%) | -0.157 | -0.786 | -0.244 | -0.088 | 0.085 | 0.215 | 0.190 |
| LinalP (%) | -0.151 | -0.005 | 0.145 | -0.240 | 0.360 | 0.627 | -0.104 |
| CitroP (%) | -0.608 | 0.415 | -0.006 | 0.106 | 0.166 | 0.436 | -0.063 |
| 3,7-DP (%) | 0.719 | -0.470 | -0.046 | -0.258 | 0.019 | -0.169 | -0.046 |
| Eigenvalue | 3.787 | 3.447 | 2.774 | 2.422 | 1.519 | 1.323 | 1.167 |
| Variance contribution rate | 18.933 | 17.236 | 13.869 | 12.110 | 7.596 | 6.613 | 5.834 |
| Cummulative contribution rate | 18.933 | 36.169 | 50.039 | 62.149 | 69.745 | 76.358 | 82.192 |

TH, tree height; GD, ground diameter; CW, crown width; FFY, fresh fruit yield; TSDW, thousand seed dry weight; TSFW, thousand seed fresh weight; WC, water content; PR, pericarp ratio; P:K, pericarp:kernel; EO content, essential oil content; CitrP, citral proportion; NeralP, the proportion of neral; GeranialP, the proportion of geranial; 4M3PP, the proportion of 4-methyl-3-pentenal; 1CCP4OP, proportion of 1-(cyclopanecarbonyl)Piperidin-4-one; SabP, the proportion of Sabinene; D-LP, the proportion of D-limonene; LinalP, the proportion of linalool; CitroP, the proportion of citronellal; 3,7-DP, the proportion of 3,7-dimethyl-3,6-octadienal.

Table S17 Statistics of D value of comprehensive score of single trees

| Single tree | D value | Rank | Single tree | D value | Rank | Single tree | D value | Rank |
|-------------|---------|------|-------------|---------|------|-------------|---------|------|
| YS-825 | 1.21 | 1 | YX-1026 | 0.36 | 48 | YX-1027 | 0.16 | 95 |
| XF-1467 | 1.11 | 2 | AF-1036 | 0.36 | 49 | TH-1047 | 0.16 | 96 |
| QN-1394 | 1.03 | 3 | ND-1182 | 0.36 | 50 | LC-1062a | 0.16 | 97 |
| ND-1187 | 1.03 | 4 | RJ-1208 | 0.35 | 51 | QN-1237 | 0.16 | 98 |
| WA-1094 | 0.99 | 5 | AF-1039 | 0.34 | 52 | QN-1240 | 0.16 | 99 |
| LP-820 | 0.99 | 6 | XS-1381 | 0.33 | 53 | DY-1457 | 0.16 | 100 |
| LP-813 | 0.92 | 7 | YS-829 | 0.31 | 54 | XF-1469 | 0.16 | 101 |
| XF-1468 | 0.84 | 8 | WA-1100 | 0.30 | 55 | GX-1102 | 0.16 | 102 |
| FL-808 | 0.84 | 9 | WN-1368 | 0.30 | 56 | PX-1010 | 0.15 | 103 |
| PX-1008 | 0.80 | 10 | HC-1217 | 0.30 | 57 | XS-1383 | 0.15 | 104 |
| GX-835 | 0.80 | 11 | PX-1116 | 0.29 | 58 | TH-1049 | 0.14 | 105 |
| AF-1031 | 0.79 | 12 | LC-1375 | 0.29 | 59 | XF-1470 | 0.14 | 106 |
| ND-1185 | 0.78 | 13 | PX-1001 | 0.28 | 60 | YS-822 | 0.14 | 107 |
| GX-1149 | 0.73 | 14 | JA-1043 | 0.28 | 61 | AF-1033 | 0.13 | 108 |
| QN-1233 | 0.67 | 15 | TH-1048 | 0.28 | 62 | ND-1186 | 0.13 | 109 |
| LH-1015 | 0.64 | 16 | LH-1016 | 0.27 | 63 | FL-807 | 0.13 | 110 |
| LP-812 | 0.62 | 17 | QN-1238 | 0.27 | 64 | DY-1459 | 0.12 | 111 |
| WA-1098 | 0.61 | 18 | YD-1195b | 0.27 | 65 | PX-1003 | 0.11 | 112 |
| XF-1462 | 0.61 | 19 | TH-1046 | 0.26 | 66 | JA-1041 | 0.11 | 113 |
| YX-1030 | 0.56 | 20 | XF-1227 | 0.26 | 67 | LC-1060b | 0.11 | 114 |
| WN-1367 | 0.55 | 21 | XF-1228b | 0.26 | 68 | DY-1456 | 0.11 | 115 |
| LC-1374 | 0.55 | 22 | XF-1466 | 0.26 | 69 | XF-1464 | 0.11 | 116 |
| XF-1465 | 0.53 | 23 | FL-805 | 0.26 | 70 | HC-1220 | 0.11 | 117 |
| YD-1194 | 0.53 | 24 | FL-810 | 0.26 | 71 | YX-1024 | 0.10 | 118 |
| FL-803 | 0.53 | 25 | PX-1111 | 0.25 | 72 | YX-1028 | 0.10 | 119 |
| PX-1002 | 0.51 | 26 | WA-1091 | 0.25 | 73 | WA-1093 | 0.10 | 120 |
| LC-1060a | 0.51 | 27 | HC-1371 | 0.25 | 74 | QN-1437 | 0.10 | 121 |
| XS-1385 | 0.49 | 28 | YD-1193 | 0.25 | 75 | GX-1147 | 0.09 | 122 |
| GX-1150 | 0.49 | 29 | LP-815 | 0.25 | 76 | HC-1221 | 0.08 | 123 |
| RJ-1209 | 0.48 | 30 | YX-1021 | 0.24 | 77 | DY-1460 | 0.07 | 124 |
| AF-1034 | 0.47 | 31 | LC-1064 | 0.24 | 78 | LP-814 | 0.07 | 125 |
| QN-1239 | 0.47 | 32 | GX-1104 | 0.24 | 79 | TH-1044 | 0.06 | 126 |
| LH-1020 | 0.46 | 33 | LP-818 | 0.24 | 80 | DY-1248 | 0.06 | 127 |
| HC-1216 | 0.46 | 34 | XF-1226 | 0.23 | 81 | YD-1196 | 0.06 | 128 |
| LC-1059a | 0.44 | 35 | XF-1228a | 0.23 | 82 | LC-1061 | 0.05 | 129 |
| LH-1018 | 0.43 | 36 | XF-1230 | 0.23 | 83 | TH-1045 | 0.04 | 130 |
| XF-1223 | 0.43 | 37 | GX-1101 | 0.23 | 84 | LC-1059b | 0.04 | 131 |
| GX-1005 | 0.43 | 38 | YD-1197 | 0.22 | 85 | HC-1391 | 0.04 | 132 |
| LP-819 | 0.43 | 39 | PX-1114 | 0.21 | 86 | FL-806 | 0.04 | 133 |
| AF-1037 | 0.42 | 40 | LC-1062b | 0.21 | 87 | GX-839 | 0.04 | 134 |
| LC-1373 | 0.41 | 41 | RJ-1203 | 0.20 | 88 | WN-1369 | 0.03 | 135 |
| DY-1247 | 0.40 | 42 | YX-1025 | 0.19 | 89 | HC-1222 | 0.03 | 136 |
| YD-1195a | 0.40 | 43 | YX-1029 | 0.19 | 90 | YS-830 | 0.02 | 137 |
| AF-1038 | 0.38 | 44 | GX-833 | 0.19 | 91 | LH-1019 | 0.01 | 138 |
| QN-1393 | 0.38 | 45 | YX-1022 | 0.18 | 92 | LC-1063 | 0.01 | 139 |
| LH-1014 | 0.37 | 46 | YX-1023 | 0.17 | 93 | JA-1042 | 0.00 | 140 |
| XF-1229 | 0.37 | 47 | XF-1463 | 0.17 | 94 | DY-1455 | 0.00 | 141 |

The samples marked with letter a are taken in 2021, and those marked with letter b are taken in 2022.