**Supplementary Table S1.** Scheme of North Carolina II (NC II) incomplete factorial mating design, with 24 cocoa hybrids

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Male | Female |  |  |  |  |
|  | PA 150 | T79/501 | SCA 6 | T60/887 | PA 7 |
| CCN 51 | + | + | + | -a | - |
| CRG 6035 | + | + | - | + | + |
| MAN 15/2 | + | + | + | + | + |
| PA 121 | + | + | + | + | - |
| Pound 10 | + | + | + | + | + |
| SCA 9 | + | + | - | - | + |

a Not included due to unsuccessful cross

**Supplementary Table S2.** The pedigree of hybrids obtained from four cocoa seed garden stations of the Seed Production Division.

|  |  |  |
| --- | --- | --- |
| Location | Female | Male(s) |
| Apedwa | T79/501 | IMC 60 and IMC 76 |
| Bunso | PA 7 | NA 33, T85/799 and P30 |
| Oyoko | T60/887 | T85/799 |
| Pankese | T63/971 | P30 and T65/238 |

**Supplementary Table S3.** Soil properties of the experimental site

|  |  |  |  |
| --- | --- | --- | --- |
| Soil property |  | Depth of soil |  |
|  | **0 – 20 cm** | **20 – 40 cm** | **40 – 60 cm** |
| Organic Carbon (%) | 1.23 ± 0.207 | 0.76 ± 0.140 | 0.71 ± 0.122 |
| Total N (%) | 0.14 ± 0.056 | 0.79 ± 0.019 | 0.73 ± 0.015 |
| Bray Available P (ppm) | 12.10 ± 1.143 | 5.82 ± 0.519 | 5.272 ± 0.437 |
| Exchangeable K (meq/100 g soil) | 0.77 ± 0.022 | 0.73 ± 0.016 | 0.59 ± 0.020 |
| Ca (meq/100 g soil) | 5.12 ± 0.210 | 3.45 ± 0.145 | 3.09 ± 0.103 |
| Mg (meq/100 g soil) | 1.05 ± 0.123 | 0.57 ± 0.104 | 0.59 ± 0.111 |
| PH | 5.41 ± 0.041 | 5.40 ± 0.020 | 5.16 ± 0.028 |
| Textural Class) | Sandy loam (80% Sand, ±2.0) | | |

**Supplementary Table S4.** Climatic data between 2017 and 2022 at Tafo, Ghana

|  |  |  |  |
| --- | --- | --- | --- |
| Period | Total rainfall  (mm) | Mean Temperature (◦ C) at 1500 h | Mean relative humidity (%) at 1500 h |
| 2017 | 1651.2 | 32.2 | 66.9 |
| 2018 | 1423.7 | 32.1 | 64.7 |
| 2019 | 1434.4 | 32.3 | 66.2 |
| 2020 | 1397.7 | 32.4 | 61.8 |
| 2021 | 1467.9 | 26.6 | 54.1 |
| 2022 | 1394.7 | 32.2 | 61.2 |
| Mean | 1461.6 | 31.3 | 62.5 |